THINGS-TO-KNOW SERIES

THE NATURE OF MAN

GEORGE A. DORSEY

HARPER & BROTHERS - PUBLISHERS

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BY

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THINGS-TO-KNOW SERIES

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THE NATURE OF MAN

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· PREFACE ·

IGNORANCE may once have been bliss; today it is folly not to be wise—for wisdom is cheap and ignorance is dear, and the blissfully ignorant dwell in a fool's paradise. Ignorance of human nature is especially dear. The price is stinted lives, maimed bodies, abnormal conduct, and social chaos—deformity and insanity, crime and disease, stupid competition, and hideous wars; appallingly heavy burdens which must be removed from humanity's back or it will break, and the accumulated fruits of all human endeavor will be buried beneath the débris of civilization. Human affairs have reached a crisis—the greatest since our ancestors left the trees to face the world with their naked bodies. They fought nature with their untutored wits; this crisis must be met with modern wisdom. Knowledge of the nature of Man can alone illumine the problems which today confront parents and teachers, communities and nations, taxpayers and rulers. To be ignorant of that knowledge is to grope in the dark when there is light, to starve in the midst of plenty, to exist when it is possible to live, and kill time and waste energy in brainless and stupid ways in an interesting world which can be made a paradise.

The Nature of Man attempts to introduce you to that knowledge—of yourself, of your fellow men, and of the world of human affairs in which you live. It aims especially to introduce you to the important known facts of human nature and to such biologic hypotheses as can be made to work and which seem to describe the nature

of Man better than the hypotheses advanced by our ancestors.

The hypotheses, for example, that little is known of the laws of physical inheritance and nothing of so-called mental inheritance, that there is no inherent virtue in this or that race, that "thinking" is talking to ourselves, and that we have no "mind" at all and know nothing of "souls" or "creators," seem to be sound hypotheses, serviceable scientific inferences.

This book is not based on "revelation," is not concerned with the Meanings or the Whys of things, nor does it attempt to solve the Riddle of the Universe or of Man—or read stars, crystals, palms, or faces, or converse with ghosts. It is based on observation and inference; it describes and deals with *how*. It could not have been written without incurring heavy indebtedness to that army of the curious who have observed openly, described courageously, and feared nothing so much as ignorance—the real benefactors of mankind who alone can point the road to freedom.

To three friends who read portions of this book in proof and made valued suggestions, I am especially indebted: Professor R. G. Hoskins, Chapter II; Professor Adolph H. Schultz, Chapter III; and Dr. John B. Watson, Chapter IV.

GEORGE A. DORSEY.

New York City, January, 1927.

· THE · NATURE · OF · MAN ·

CHAPTER ONE

Introducing "Man," "Nature," and "Behavior"

BY "MAN" I mean any human being, every human being—yesterday, today, tomorrow; you and me.

We are astonishingly alike, all of us; alike in the life that is in us, in our bodies, in our ways of bodily behavior. There are individual differences, of course—differences due to ancestors, to upbringing, to opportunity, and to age and sex. But all human beings are in all respects so much alike that no one mistakes them for gorillas or chimpanzees or for any other animal. And they have been unmistakably alike since long before recorded history. In a hundred thousand years there has been no really great or important change in Man or in the fundamentals of human nature.

It follows, then, that everything said in this book may be taken personally—always remembering that every person is the offspring of a particular pair of parents, is of a certain sex, is born at a specific time and in a particular locality, grows up in a specific social environment, and between birth and death passes through a definite cycle of structural change. Individual life cycle, sex, and parents are inborn or innate factors in the life of every human being; the time, the place, and the upbringing are not innate—they depend on circumstances. This distinction between innate factors (or nature) and "circumstances" (or nurture) is of fundamental importance in understanding human beings.

"Nature," as used in the title of this book, means what is known about Man. You ask a chemist about the "nature" of water, and he will reply "H_2O," or he will

tell you a long story. A vast deal is known about water —but not all. No chemist knows all about water, or all about either of the two gases which unite to form water. No one knows all about anything. But more is now known about everything than was ever known before. And this is especially true of Man.

Our ancestors made clever observations about many things, but were curiously ignorant of themselves. They peopled the universe with spirits and then invented a Supreme Spirit to account for the spirits and for themselves. Millions of people today believe that man was created out of nothing and woman out of one of his ribs. Nor can any biologist prove that "Adam and Eve" were not thus "created"; he can say that that belief runs counter to all that he knows, that he knows nothing which supports such a belief, but that everything he knows supports the hypothesis that human beings evolved from animals which were not human—and they, in turn, from other animals which were even less "human," and so on. And that all this took much time.

He finds the evidence for this hypothesis in paleontology, zoölogy, anatomy, embryology, physiology, and history. This evidence is so abundant and so overwhelmingly conclusive that no living biologist doubts evolution or believes that Man was specially created.

The "nature" of Man, then, is what is known about Man. Enough is now known, for example, about human blood to fill a huge volume; the physico-chemical nature of one molecule of one human red blood cell is not yet known, so inconceivably complex is it. But so little was known about human blood four generations ago that Washington was bled to death to save his life!

Much of the nature of Man is now known. It is not too much to expect that some time enough will be known of his nature to deliver its control into his own hands. For it should not be forgotten that when science knows the formula for a thing, it can make it; when it understands a thing, it can put its brain into it and drive it!

Control over disease began with knowledge of the cause of disease.

How does science "know"? Lack of clearness on this point is responsible for countless superstitions which circulate today as gold coin—current because we get into the habit of believing what we are told or what we read just because somebody has told it or written it. Especially are we credulous of the printed page. Millions of boys and girls grow up blissfully confident of the truth of everything in print. They come to put more trust in the printed page than in their own eyes and ears. "The book says so—it must be true." Then, too, reading, next to sleep, is for many people the easiest time-killer—it saves them from "thinking," especially if they have nothing with which to "think"!

What, then, is "thinking"? We must anticipate a little; otherwise we shall not be able to understand "knowing."

Roughly speaking, thinking is action in the voice mechanism—mouth, throat, etc.; but it is silent—no sound is uttered; and it is slight action only—no movement in throat or mouth is perceptible. The action itself results in words. In short, when we think we are "talking" to ourselves. We talk not only in words, but, if we are deaf mutes, in signs; and in shrugs, gestures, grimaces, etc. But most of our talking is in words. Words are substitutes for things, objects, qualities, quantities, etc. With a large vocabulary we can manipulate the objective world while sitting in a chair or lying in bed or while engaged in more strenuous occupations. Without words, human civilization would not have been possible. Think this over with yourself.

This world we think (and talk and write) about is the world we name with words. We *know* it by observation and by inference. We "observe" with our eyes, ears, nose, tongue, and tactile and temperature organs in our skin and within our body—with our *sense* organs. Through them we keep in "touch" with ourselves and

with the world; without them we have no sense, nor can we "observe" anything.

From the evidence obtained through our sense organs we can *infer* certain things just beyond reach of our sense organs. Our inferences are often incorrect, but science and "common sense" are always striving to extend their observations in order to revise or check up their inferences.

Superstitions, false and erroneous beliefs, and fairy tales and ghost stories in general, arose (and arise, for we are still of childish simplicity) from false inferences —inferences drawn from scant observation or from mere "thinking." By our early ancestors, strange lights and noises were inferred to arise from ghosts. Knowing nothing of the history of the earth, nor of the relationships between animals and plants, nor of the ancestry of human beings, they inferred that earth and sun, moon and stars, and living beings were "created" by a superman. And who was the superman? The "creator." Ghosts and spirits and creators were all invented by human beings—by our ancestors, who felt impelled to name things they could not observe because they could not account for what they did observe in any other way. From hasty or faulty observation, they necessarily made inferences which to us seem childish.

All this seems simple enough; it is simple, and thereby eludes many who prefer the complex to the simple, and the mysterious to the verifiable facts of observation. Mere words, as we shall see, are learned during our childhood under emotional stress—they come to us "loaded"; we learn to be afraid of them, we learn to respect them, to venerate them, to consider them as above observation, beyond the bounds of our eyes, ears, nose, and other sense organs. They enter into our articles of faith; we take them on trust. It is safe to say that half the beliefs held by mankind today are not founded on any known verifiable fact; nor is there biologic justification for most of the paraphernalia of

modern civilization. We accept it naïvely and implicitly because we grew up in it; we suffer it as we do disease, crime, poverty, and ignorance, because we became habituated to it in childhood; and the imbecilities and stupidities are handed on from generation to generation.

Science knows—all, always? Certainly not. Science grows, revises, casts out, extends, enlarges. How? By new observations, by new inferences. Its goal is not Finality, or Ultimate, or Perfect, but more—more knowledge, such knowledge as will yield better control. And it observes with eyes, ears, nose, tongue, tactile organs, and especially these days with man-made extensions of eyes, ears, etc.—with microscope, telescope, spectroscope, microphone, marvelously delicate balances, and marvelously refined chemical analyses. With these extensions of rather inferior human sense organs science observes, and in symbols, words, and phrases describes its observations and the conclusions and inferences drawn therefrom. There is no mystery about it, nor "method" beyond that of common sense. But it does say, "I know," or, "I do not know," or, "I do not yet know"; and it does hold that the "knowable" is always within range of human observation. Beyond that, science leaves the Meaning of the Universe, the Destiny of Man, and the Immortality of the Soul, to poets and philosophers, metaphysicians and theologians.

Brief descriptions of science are called "laws." They are extraordinarily valuable tools—as important as any invented by Man. Without them, there could be no science. What is not always clear is that these laws are man-made and have no objective existence. They are, in short, inferences from observation. Their value as tools lies in their summing-up large series or numbers of observations. They do not *explain;* they do describe. For example, the formula H_2O is the chemist's way of describing water—water is a compound of two molecules of hydrogen and one of oxygen. That formula (H_2O) is the "law" of water—it is a law of nature;

from that law we infer that water has always been H_2O and predict that it always will be H_2O. No law of nature says more or describes more.

Hence, the expression "unchangeable" (or "immutable") laws of nature is bad science: it says in effect that nature does not change. Whether nature does or does not change is beside the point: the point is that every law of nature is a man-made law and Man revises his "laws" as often as need be to keep his laws in conformity with his observations. New observations often compel revision of laws. As soon as a "law" is found to be based on incorrect or insufficient evidence (observation), it is started on the road to the scrap heap. The laws of astronomy today are no more the ancient laws of astronomy than is modern medical practice that of the ancient Egyptians.

Modern science is better than ancient science not because it is modern but because modern tools have made possible such observations as to force scientists to abandon the old laws and find new ones. The old laws do not describe in brief shorthand concepts what can now be observed. The sciences of chemistry, physics, astronomy, geology, biology, physiology, etc., are not only modern sciences but they are living, growing sciences. Their textbooks are being constantly revised, rewritten, and improved. But the "mental" sciences have made no real advance since Aristotle. They are the family albums handed down to us from the ancient world. Imagine a modern medical school using Hippocrates as a textbook of anatomy!

The nature of Man is what is known of Man. This knowledge has not been gained through speculation nor by revelation from on high, but by observation—in the field, in the street, in the laboratory, in sickness and in health, in life and in death, from the fertilization of the ovum to birth, from the cradle to the grave, and from past times to the present.

This knowledge today is so vast that a lifetime could

be spent on a single phase of human behavior without exhausting it. And all this because the capacity of human sense organs to *sense* has been extended and because more trained and competent observers are at work today than ever before. To all this knowledge this little book is, I repeat, merely an introduction.

But where shall we begin? And how shall we know when to leave off and say, "You have met Man"? Can we not find our clue in the statement already made that all human beings, present and past, have certain fundamental features in common? If we can get these common features before us, we can easily turn to individuals: to know the nature of Man is to know the nature of every human being that ever lived. It is true, as Tennyson said, that if we knew all about that flower in the crannied wall, we should know all about everything. It is equally true, and nearer to the point, that a general understanding of the nature of the vegetable kingdom would supply a speaking acquaintance with that particular flower in that particular cranny.

The chief difference between you and Tennyson is incidence of parentage and accidents of time and place. The question we have to answer is: How can this incidence of parentage and these accidents of time and place be expressed? Put in that form, the answer seems obvious: you both are human beings because you sprang from human parents; your manner of living was not inherited, but acquired after birth. To put it another way, every human being has a physical body of certain general proportions and with certain physical traits. The character (size, shape, etc., etc.) of that body depends in general on the character of the male and female bodies of which it is a part. What that body does after birth depends on what it learns to do and what opportunities it has to exhibit its learning.

Here, then, we have three concrete problems: What keeps this physical body going during life—the problem of life, or *visceral* behavior; what is the origin of this

physical body—or *genetic* behavior; how does the body act after birth—or *somatic* (bodily) behavior.

But no human being lives unto himself; each one of us is a member of a family, a community, a tribe, a nation. This, then, gives us the problem of family relationships, or *social* behavior. But our social ways are not the ways of our ancestors: we have steam heat and radios, automobiles and motion pictures, newspapers and aëroplanes, anæsthetics and synthetic indigo; our ancestors had none of these, and their remote ancestors had nothing of civilization, but died as they were born, naked and unashamed. How came civilization to be born? How did it grow? This gives us another problem, that of *cultural* behavior.

These are not distinct phases of human behavior, of course; they are so interrelated that no one phase can be understood without some understanding of all. Indeed, there is no phase of human nature that does not involve the nature of the universe—including the flower in the crannied wall. Each phase is simply one aspect of the nature of Man, treated here as a distinct problem merely for convenience.

"Behavior" simply means the way a thing behaves or cuts up. Everything—flower, earthworm, snow crystal, grain of sand, hydrogen atom, human being, corpse—has its own behavior. The way a human being cuts up is often spoken of as the object of study of psychology. But psychology is still shot through and through with the doctrine of souls and is still largely a form of literature based on hypotheses of "intellectual" values, group "minds," specific "instincts," etc. We do not need these hypotheses. We do need to observe Man in his various forms of behavior before we can know him and describe him in terms which have standing in any court of science. We must try to observe Man as an astronomer observes stars.

We turn first, then, to Man's visceral behavior: How does he live, what keeps him going, where does his vital energy come from?

CHAPTER TWO

How Man Lives: Visceral Behavior

A HUMAN being is a *being*—a something doing, responding. This implies work performed and a mechanism which performs work.

Now, the mere introduction of the word "mechanism" causes many otherwise reasonable people to exclaim against calling a human being a mere *mechanism*: "Man is more than that!" He is indeed; but it will not degrade him nor alter his nature to consider him for the present as a mechanism—a mechanism of a very special kind and of inconceivable complexity. The history of this mechanism we shall consider in the next chapter; we are now concerned with it as a *living* mechanism and as a *growing* mechanism; in short, as a *being*.

Living, growing, being, imply action—work performed, energy transformed.

For example. As I write these words, action is taking place in certain specific mechanisms in my arms: muscle-engines are at work, transforming energy. Muscle-engines, work, and energy are just as definite and as specific as are the engine, work, and energy involved in a motor car in action.

As you read these words you also transform energy in certain specific muscle-engines—in the muscles of your arm which hold the book, in the muscles of your eyes which move them back and forth across the printed page.

We are indeed more than mere mechanisms; we are mechanisms of infinite parts. Each part has its specific work to do, each part has its specific relation to the

entire mechanism—the living organism, you, me. And each part is a consumer or transformer of energy.

Where does this energy come from? What is the "fuel" which drives the muscle-engines of my arm while I write and the muscle-engines of your eyes while you read? It used to be called "vital spirits" and was considered so mysterious that a supernatural being was invented to account for it. Even today there is a Vitalistic philosophy of life. But to account for something not well understood by giving it a name and then solving all the details of the problem by merely uttering the name, is to take the entire problem out of court and leave it where it was at the beginning. And this is to stifle healthy innate human curiosity to explore everything in the universe within reach of human sense organs.

The entire story of human energy is not yet known, but the main facts are now so well known as to be within reach of everyone who can read. There is no more mystery about the energy which makes us go and keeps us alive than there is about the energy which keeps a locomotive or an automobile engine going: fuel is burned, releasing energy which appears as heat and work performed. The fuel "burned" in the muscle-engines of arms and eyes is fundamentally the same as the fuel burned in a fireplace or in an automobile engine. It is a carbon compound; during combustion it is "oxidized." Just *why* carbon compounds (such as coal, petrol, sugar, starch, etc.) should under certain conditions unite with oxygen and release energy is not known. But they do; it is their *nature*. During combustion they become carbon dioxide (carbonic-acid gas) —in your arm, in your automobile engine.

Where do carbon compounds come from? Chemical laboratories, these days; but the carbon compounds we burn for our energy come from food, and the primary source of the energy stored in them is the sun.

The sun's rays acting on green plants drive them to

combine simple chemical elements into complex elements—such as sugars and starches, fats and proteins. Animals, including, of course, human beings, do not have this power to combine simple elements into the complex compounds which they require for building their bodies and for the energy consumed during building and living operations. Herein lies the fundamental difference between plants and animals—and the key to their evolution. Plants must keep in touch with the sun; animals must keep in touch with plants.

"Vitality," then, is simply solar energy stored in complex carbon compounds, which when burned or oxidized release energy—heat and work.

We eat these complex carbon compounds—sugars, starches, fats, etc.; our digestive system (alimentary canal and appendages) breaks them into simpler compounds. These enter into the blood stream (the circulatory system) and are carried about the body, to be used by any part of the bodily mechanism which requires fuel. Our vital parts require fuel all the time, for they never stop working as long as we live.

Ordinarily, all our bodily mechanisms have a certain amount of physiological fuel stored up for instant action. Our liver especially is, among other things, a storehouse for physiological fuel, and releases it into the blood stream when demanded. After much work in any mechanism its fuel supply runs low, and the end product of combustion (carbon dioxide) becomes excessive in the blood, making us breathe faster, and we become tired or "fatigued" from the acid phosphates (chiefly $KH_2 PO_4$) given off by the overworked muscle.

This physiological fuel (carbon compounds) cannot be burned without oxygen. Oxygen is abundant in the air we breathe, but is difficult to capture. For this purpose our blood has a special mechanism—a red blood cell. We have about 30,000,000,000 of them—enough, were these little disk-shaped objects placed edge to edge, to reach nearly two hundred miles, or placed side

by side, to have a combined surface area of 4,000 square yards.

These red cells are carried through the lungs once every fifteen seconds. In the lungs they are separated from the air we breathe by two thin membranes through which they obtain oxygen from the inhaled air, and at the same time deliver the excess carbon dioxide. Hence it is that there is less oxygen and more carbon dioxide in the air we exhale than in the air we inhale.

Lungs, windpipe, and muscles which work the bellows in breathing (together with nerves, etc.) make up our respiratory system. The membrane itself which lines the lungs has a surface about fifty times as large as the skin surface of the entire body—roughly, ninety square yards!

But the human body is more than a mere *being;* it is a *growing* mechanism.

No one knows what life is, but there are certain good criteria of life; one we have just seen, the transformation of energy through the oxidation of carbon compounds. Every living organism is always "breathing," though its "vitality" may be so low that it cannot be easily detected. But the fundamental criterion of life is *growth,* self-reformation, spontaneous regeneration.

Growth, of course, is not confined to living beings; clouds, deltas, crystals, etc., *grow,* but they are not *alive.* The molecules of a crystal are stable, and imperishable so long as the crystal endures. The molecules which collect on the crystal during its growth exist, already made, in the surrounding solution. The molecules of living organisms are unstable and perishable. The molecules which are added during growth are transformed in the very process of growth under the influence of the molecules already formed.

These molecules which make up living matter (protoplasm: first-formed) are always compounds of carbon, hydrogen, nitrogen, sulphur, phosphorus, and oxygen,

and certain inorganic salts or ions; such molecules exist only in living matter in watery solutions.

These unstable molecules have the unique power, in Professor Leathes' words, "of forever reforming themselves out of simpler combinations that do not exhibit this property, and do so at a rate which averages at least not less than that at which they break down."

The fundamental criterion of life, then, is growth or self-reformation. Without this power there is no life. During life this power can be exhibited only through the oxidation of some of the molecules within the living organism.

Here, then, we have, incidentally, something of the nature of the chemico-physical basis of human beings and all living protoplasm: molecules of huge size and of incalculable complexity. Because they are big and complex they behave like dynamic mechanisms, and exhibit unique power—the power to live!

The *living* molecules of living organisms are the protein molecules, of which there are incalculable varieties. The basis of the protein molecule is an amino-acid, of which there are about twenty varieties. In the possible combinations of these amino-acids lie the incalculable number of varieties of proteins.

These amino-acids are the building blocks of the animal world. With them the fertilized human ovum begins to build the human body. One cell grows and becomes two; the two grow and become four; and so on, until at birth there are about 26,000,000,000,000 distinct and individual cells in the human body. These building blocks are obtained by the developing ovum from the blood of the mother; after birth, from its own digestive system, and put into circulation by its own blood stream.

This gives us an additional view of the part played by the digestive and circulatory systems in the fundamental processes of living. The protein molecules in milk, string beans, and beefsteak are too large to pass

through the wall of the alimentary canal into the blood stream; they must be broken up into smaller molecules —as must also the large molecules of complex sugars, starches, and fats.

Digestion, then, consists in breaking up large molecules into simpler ones, in tearing down what was once a living structure and is now dead into its component "bricks." These are built into the living body or are burned to furnish the motive power required during the building and repair of that living body. The building blocks and fuel thus liberated during digestion in the alimentary canal pass into the blood stream, and by it are carried throughout the body every twenty-three seconds, to be delivered wherever supplies are required. The circulatory system is a *transport* system, supplying the needs of every cell in the body and carrying away its refuse.

Digestion is an enormously complex process. It involves the physical handling of food from the mouth to the end of the thirty-foot-long alimentary canal; it involves chemical treatment of the food—special secretions from specific glands in mouth, stomach, and intestine, and in pancreas and liver, which contain enzymes or ferments which act as catalyzers and bring about or hasten chemical reaction.

The digestive system, then, is a physical mechanism for the handling of food and the elimination of waste, and a chemical laboratory for reducing complex carbon compounds into simpler compounds. The circulatory system is a complex system of pipes and tubes for delivering supplies and collecting garbage. Both digestive and circulatory systems are driven by muscle-engines. These muscles are "smooth" or unstriped, thereby differing from the muscles which are attached to the bones of the skeleton and by which the motor mechanism is moved. The heart is a powerful muscular pump, receiving blood from the lungs and the great veins, and driving blood to the lungs and into the great artery

or aorta, from which it passes finally into the capillaries and so to every cell of the body. A clot in the blood large enough to stop circulation is fatal—as may be a small clot in a coronary vessel, even though it influences circulation very little. Circulation is a vital function, as are respiration and digestion.

Digestion is primarily a chemical operation. Chemical reactions take place with the aid of catalyzers, or with great heat. The human chemical laboratory is set for reactions with catalyzers and a certain specific degree of heat, say 99°. After a glass of ice water the stomach must slow its business of digestion until it warms that water to blood heat; then it can go on with its business.

It is not so true that we are *warm*-blooded animals as that we are *constant*-temperature animals. When our temperature varies ever so little from that normal, compensatory action must take place somewhere, somehow, or we die. When the temperature rises above 105° the danger point is near: protoplasm changes irreversibly at about that point—it becomes literally "soft-boiled." Irreversible change in protoplasm spells death.

The mechanisms involved in keeping the body temperature normal under the heat generated by violent exercise or under the heat of Death Valley or in the cold of the Arctics, are extremely complicated and are not yet perfectly understood. But human life depends, among other things, on the continuous and successful operation of these mechanisms.

Briefly, we sweat or we shiver. In one, we lose heat, in the other, we generate heat. We "receive" heat and cold in hot and cold "receptors" in our skin. Under stimulus of these receptors we sweat or shiver—or turn on an electric fan or the steam radiator. The fact that it is our nature to suffer extremes of heat and cold and that we have no adequate natural hair coat for protection either against the sun's rays or against cold weather, has had a far-reaching influence in molding

human culture. It is one of many illustrations that what we do is largely determined by what we are, that human nature is at the foundation of human nurture (culture).

When the one-celled human embryo divides and becomes two cells, the two cells are as alike as two peas. But after division has continued for a few hours, the cells begin to differ in shape and, necessarily, in relative positions. At least we must infer they do, for no one has yet seen a human embryo that was not over ten days old; and by that time it had begun to have distinguishable parts. Under the microscope the cells of these parts are seen to have assumed special forms or shapes—their nature has changed, their behavior has changed. A process of differentiation has begun whereby different groups of cells can do certain kinds of work. Some are adapted to become nerve tissue, others muscle tissue, others lining tissue, others glandular tissue, etc.

Differentiation, specialization. A full-grown nerve cell looks no more like a muscle cell than brain looks like steak or an elm tree looks like a toothpick. Something seems to happen to these highly specialized cells besides mere differentiation—they lose their youth! And they cannot be rejuvenated; at least, the secret of their rejuvenescence has not yet been discovered. They grow old and wear out. When any *vital* organ wears out, we die.

Some cells—connective-tissue cells, for example—seem to retain their youth; they retain the capacity to grow and multiply. Why they grow so amazingly in epithelium to form tumors (cancer) is yet a baffling mystery, presumably not insoluble. But certain cells, while becoming highly differentiated, retain the power of becoming young—they can be rejuvenated and start a fresh life. Such are the cells, early set aside in the developing embryo, which become the reproductive or "germ" cells: ova in the female, sperma in the male.

When sperm cell enters ovum cell, as in fertilization, the result is a single cell: the fertilized ovum or human embryo in its earliest stage. This ovum has now the capacity of developing into a human infant—provided, of course, it receives proper protection and an adequate supply of building blocks and energy units from its host, the mother.

Now, a cell cut from the heart of an embryo will grow and multiply provided it is kept in a proper solution. But it will only grow more heart (muscle) cells. The ovum develops into an eight or nine pound baby. The ovum was an old cell, highly differentiated from the other cells of the body, although a primitive cell in its latent possibilities; fertilization rejuvenated it. It can now grow, develop, become an infant.

"Immortality" is a figure of speech, biologically speaking. The single-celled amœba divides: what was one amœba is now two; there has been no "death" because there is no corpse. The amœba is endowed with potential "immortality." Every amœba alive today sprang (by division) from a preëxisting amœba, back to the first amœba ancestor, and back to primordial protoplasm. But before the parent of this particular amœba divided, this particular amœba had no individual existence.

Ditto for human beings. Every human being living today sprang from fragments of the bodies of two preëxisting human beings. Reproduction (or rejuvenescence) in higher animals is not by division of a single individual organism, but by the conjugation of fragments of two adult organisms. They die; the "fragments" live. The fragments are "immortal"—but only by the route of germ cells; otherwise they all die.

The mechanisms which contain the germ cells (ammunition for the next generation) and which make reproduction possible, are not *vital* mechanisms; they can be injured or excised without fatal results. They are essential for purposes of reproduction only. They do,

however, form part of the *viscera*. And the viscera, for the life of the individual and the race, are vital organs.

These vital organs fill the thoracic, abdominal, and pelvic cavities—respiratory, alimentary, circulatory, and urogenital systems. They have come, in Man, to have certain specific forms, shapes, sizes, proportions, etc., all clearly derived from our ape ancestors, and varying enormously from individual to individual. But these viscera perform no function that is not performed by the lowest single-celled animal organism. The amœba breathes, eats, digests, excretes, and reproduces.

What, then, is the main difference between an amœba and a human being? Or, let us put the question in this form: If the amœba has all the "viscera" necessary for all vital processes, what has Man that the amœba has not? Greater power of control over circumstances, better ways of capturing oxygen, fuel, and building blocks, more ways of fleeing from enemies—all leading to greater freedom from environment.

This gives us a clue to the nature of organic evolution. What has evolved is not *life*, but living mechanisms which have obtained increasingly greater capacity to live, greater capacity to control the goods of life, to obtain the necessaries of life, to avoid the dangers of life. A "higher" life, then, is characterized by a mechanism more responsive to vital stimuli and with more varied modes of response.

Energy spent in railing against a "mechanistic" theory of life could be profitably directed in keeping the mechanism in repair.

We turn now to the history of the compound mechanism known as Man. Our chief interest will be the development of the particular mechanisms which give human beings their unique position as lords of the earth.

CHAPTER THREE

How Man Grows: Genetic Behavior

OUR body begins as a fertilized human ovum. That ovum (or, more properly, *embryo*) grows, develops. Into what? Well, if it is properly protected and adequately nourished, it will develop into a human infant. Why? It is its nature. It develops into a human infant for the same reason that an acorn develops into an oak tree. Ovum and acorn are fragments (seeds) of preëxisting adults: what else could human ovum develop into but a human being, or acorn but into an oak tree?

And that, in a nutshell, is heredity, about which more has been written and less is known than almost any other subject in biology. Two important points, however, must be noted.

(1) That one-cell human embryo will develop into a human infant provided only it is protected and nourished. Without such protection and nourishment it does not develop at all, or it develops only partially, and may bear no resemblance to a newborn babe. When, in experimental laboratories, eggs (of, for example, starfish or frogs) are subjected to abnormal conditions of protection and nourishment, they do not develop normally. They become freaks, monsters. Protection and nourishment may be spoken of as "environment." Eggs develop normally only when the environment is normal; and in that case they develop into beings which resemble the parent stock—provided, of course, their environment after birth is also normal (that is, favorable for normal growth). In other words, the hereditary

potentialities of the fertilized ovum are realized only in response to external factors, environment.

(2) Environment, then, is an important factor in heredity. The single-cell human embryo develops into a human infant which will grow into an adult resembling its parents, because it is a piece (a "bud," an "offshoot") of them and also because it is subjected to the same kind of physical and chemical environment in which the parents developed.

How can we assert, then, that if every living human being sprang from preëxisting human beings, and these in turn from other preëxisting human beings, and so on back in time, some hundreds of thousands of years ago there were no human beings? Well, it does sound like trying to eat one's pie and keep it. Let us see if it can be done.

Suppose we stand a tall blond of North Europe alongside a big black gorilla from Central Africa. There is no mistaking one for the other; even a child could distinguish them. What is the difference between them? Not half as much as you suppose. In fact, there is no fundamental difference: simply a little more of this and a little less of that; differences in proportions, sizes, amounts. No absolute differences—as there are between any of the four anthropoid (manlike) apes and any monkey.

Suppose we open a space between our big blond man and our big black ape, and in that space stand other human beings, from Asia, from Africa, from Australia, and still others that we call to life from a distant past and know only by their fossilized remains, such as Neanderthal Man, Rhodesian Man, Heidelberg Man, Piltdown Man, and that true missing link from Java, Pithecanthropus erectus (ape-man erect). And on the end of our line let us add the other three anthropoids—chimpanzee, orang-utan, and gibbon; and also the resurrected remains of certain fossil apes from Europe and Asia.

We now have eighteen exhibits in our line. Suppose I shuffle them up. Can you sort them out in line again, placing the most "human" at one end, the least "human" at the other? Well, if you can, you can do more than the world's anatomists can. They cannot even agree whether Pithecanthropus erectus was a *pithecus* or an *anthropus*. Darwin postulated a "missing link." A dozen have since been discovered. Pithecanthropus erectus is as good as if he had been made to order.

How, then, did an ape become an ape-man, and an ape-man become a man? No one knows, but he did, and in changing or becoming, *evolved;* and that is *Evolution.*

Just here note an important distinction. Proofs that all higher (*i.e.,* more complex) plants and animals evolved from lower plants and animals, that both plants and animals evolved from simple primordial protoplasm, and that simple primordial protoplasm evolved from simple carbon compounds, exist and are known and have been described in hundreds of volumes and are accepted by every biologist of repute on earth today; *how* this evolution took place no one yet knows.

Evolution is a fact; the *laws* of evolution are in dispute. Darwin's proposed hypothesis of Natural Selection covers only part of the truth: it helps us to understand evolution; it does not give the laws of variation, and without variation there could be no "selection." Darwin, of course, knew this even better than his critics. The laws of variation are not yet known, but it is known that individuals vary because their environment and their innate heritage vary. Evolution is known. And every living human being is a museum of anatomy in proof of it. Man's body, embryonic development, and fossilized remains disclose evidence of his prehuman ancestry as unmistakably as the noonday sun proves that the sun is hot.

How, then? We do not know. Merely to utter Evolution, Heredity, Survival, or Selection is to say

nothing that bears directly on the *how*. Experiments now under way will illumine much that is still obscure. When science knows all the laws of evolution (or of heredity) it will . . . But that time is far off; we of today shall not live to see it.

I spoke of "simple" primordial protoplasm. It was less simple than the sun. It was a mechanism of such complexity that it could rejuvenate itself, regenerate itself, build into itself simple compounds, thereby transforming them into its own incalculably complex dynamic mechanism.

Since this mechanism came into being, possibly one billion years ago, it has encountered an endlessly changing physical environment. And it changed with change. It answered change in environment by change in mechanisms, especially for capturing food and fuel from the environment; without food and fuel it perished and what was a complex mechanism became simple carbon compounds, simpler inorganic compounds, and simple elements. Thousands of forms of plant and animal life buried in the ooze of the seas and the rocks of the land left no progeny to mourn their loss—they did not change with changing environment. They had no adequate response to vital stimuli.

A bare outline of the history of Man's descent from primitive protoplasm is volumes long. A mere sketch must content us, and will, if we can get a relief-picture of what Man is as one of the products of evolution.

And this, we may remind ourselves, will not be easy. We speak of ourselves as lords of creation, deify ourselves, and assure ourselves that the universe exists for our benefit and that evolution was a failure till Man appeared; and all this may be true, but we have only our own word for it. Failing any other better or higher word, then, we can only make the best of it—and try to see with as dispassionate an eye as possible what it is that has evolved during this long period of evolving life.

Shall we say, intelligence? But what is intelligence? It has never been defined twice alike. *Who* is intelligent? "Intelligence" seems to depend upon the point of view—and always upon the point of the speaker. When we say that "intelligence" evolved, or that intelligence reached its zenith with the appearance of Man on earth, we have not said anything—nothing, at any rate, that we can get into a scientific laboratory, despite the Intelligence Testers! We must fall back on mechanisms of specific *power, capacity, adaptability.* Power to keep in touch with the vital necessaries of life, capacity to modify behavior according to experience, adaptability to meet change in environment; responsiveness to vital situations. These can be tested—in amœbæ, earthworms, rats, human beings.

These attributes Man undoubtedly has in degrees and amounts in excess of any group of animal mechanisms known to science. Fairies, elves, gnomes, spirits, angels, etc., may excel in these particulars—and do, according to many ancient and some modern beliefs; but supernatural powers are beyond the ken of scientific observation, and we may proceed on the hypothesis that they exist only as words. Words can, it is true, modify human behavior and change the personality of human lives; but that fact in itself is no more proof of the objective existence of supernatural beings or powers than were the old beliefs that the earth is flat, that witches sour milk, and that a dead ox will generate bees, proofs that the earth *is* flat, that there *are* witches, and that there *is* spontaneous generation.

Call it capacity to control the necessaries of life. What evolved, then, as represented by Man, was an extraordinarily sensitive mechanism which could learn, which could retain what it had learned, which could profit by experience, which, in short, could modify its behavior according to circumstances. This capacity is expressed in certain definite parts or mechanisms adapted for special purposes: a red blood cell, for

example, which could pick two atoms of oxygen from the air for each atom of iron in its hæmoglobin, carry the oxygen about, and deliver it where needed; a hand that could make a microscope which could enable the eye to detect the micro-organism which nests in red blood cells to their enormous injury, thereby unfitting them to do their work and diminishing Man's capacity for self-regeneration.

Which seems to bring us back to our starting point: uniqueness of life is the power for growth of a certain kind—self-regeneration. Let us see what we can make of this.

"Higher" life is greater power of self-regeneration. In the highest life we should expect to find the greatest power of self-regeneration.

Cut an earthworm in two: the head part grows a tail; the tail part grows a head. Or consider a flatworm—the planaria: it dries up in the autumn and becomes "dust"; in the spring, dust particles become flatworms. Marvelous power of self-regeneration! But an early bird can get the worm, which thereby loses its marvelous power; and an early boy can get the bird.

Self-regeneration is a good biologic concept, but it is too general to get us further along in our relief-picture of what it is that has evolved. We fall back on a mechanism or organism of enormous capacity—capacity to respond to wider ranges of situations and in more varied ways and thereby gain greater and more certain control over environment. Man represents the extension of this capacity to its highest known form. He is the most complex of all living organisms and as a result of that complexity he can live a higher life and can rule the animal world.

This capacity, as expressed in Man, is represented by certain sensory mechanisms which are touched off or stimulated by certain impulses; and by certain motor mechanisms which can make responses, thereby adjusting Man to his environment.

Disregarding these specific mechanisms for the moment, let us now trace briefly and in general the story of the growth of Man's body. Then, in the next chapter, we shall be prepared to consider how the sensory mechanisms get results through motor mechanisms, and how Man thereby realizes on his innate capacity to learn infinite ways to adjust himself to the world he finds under his feet, and to the world he creates with hands and words.

We may begin our sketch of the history of Man's descent from the mud, with the earthworm. It is a very high animal; it has parts, special mechanisms for special purposes. It not only has all the viscera necessary for a complex mechanism, it has a motor mechanism of muscles to carry the viscera to the food trough; a nervous system which correlates viscera with motor mechanism, so delicately attuned to stimuli it can sense the step of a lark. And it has a head and a tail—it can go ahead or astern.

From which it appears that by the time our ancestor had passed from a single-celled organism to an earthworm, he had made an enormous advance toward the higher life.

The next step was the fish stage—possibly the most important single step in life's journey from amœba to Man. Fins for propulsion, first-class sense organs (especially of taste, sight, touch, and gravity), a large brain, and a bony skeleton—spine, skull, ribs, and propellers. From fish Man got his spine; with fish he became a Vertebrate.

With amphibia, the next higher stage, came four limbs, vocal cords, and air-breathing apparatus. With reptilian ancestors came a more highly perfected oxygen-capturing mechanism, and a new-style egg.

With our early mammalian ancestors came a new type of brain, a self-contained incubator, and mammary glands. And when a small and insignificant insect-eating animal adopted a tree for its home, it carried all the

parts that, through lemurs, monkeys, and apes, with slight changes here and extensive alterations there, at last left the trees, walking on two legs, with an upright gait, with two hands free to do the bidding of a human brain, and faced the unknown, unnamed world.

The clue to human superiority is the human brain. We shall pay our respects to it in the next chapter. It is enough now to repeat that the history of the human body is as well known as the history of the iron industry, and better known than the history of agriculture or the history of human speech. It is known that human vocal cords began with amphibia and have since played a prime part in courtship and as a means of communicating emotional states. It is known that the keel of the human mechanism was first laid down in fishes, and that the human hand is less highly specialized than the front foot of a horse or the wing of a bird. It is known that by the time our ancestor was on the way to become a gibbon or a man he had definitely parted with an external tail and had begun to acquire such differentiation of the muscles of face, mouth, and throat that he could put "expression" in his face and character in his voice. The foundations of every essentially human trait of behavior were laid from two to six million years ago by our monkey ancestors in the trees. Certain phases of these "foundations" will be considered later in some detail.

The visible mechanisms whereby Man can claim supremacy on the hypothesis of an evolving capacity to control environment, are: the largest brain cortex, relatively, in the animal kingdom; the longest period of helpless infancy and the longest period of childhood. As a result of these factors, Man has accomplished a measure of control over his environment not attained elsewhere in the animal kingdom. He has, because he could. It was in his nature.

This all too brief history of the human body is only one version of the story of Man's genetic behavior.

Another, and an equally interesting version, is enacted by every developing human embryo. Many details of that story are yet unknown—human embryos are not readily available for laboratory study. The first ten days of the story are known only by inference from what is known of the early development of lower mammals, and especially of lower vertebrates. Of the story from the tenth to the twentieth day only parts are known directly from human material. From the twentieth day on, large volumes are known, and it is perhaps the most interesting and amazing story ever written.

The interest in the unfolding embryo is not that it is to become a human infant—it would be amazing if it did not; the interest is in the fact that during 280 days it rehearses the history of the human race! Not that on a certain day or at a certain stage it is a fish or a reptile, but that it passes through the stages our ancestors traveled when they acquired the special parts which gave them greater power over environment. It rehearses hundreds of millions of years in a few months. And it may be noted here that a few demonstrations in embryology, in a class room, or at home, or in a church, would be more convincing than all the books ever written on the "theory" of evolution.

After division has taken place for several days, the embryo assumes a platelike form with what appear to be fine lines from side to side. These are the "segments," such as appear in the earthworm, fish, etc., and such as persist in our spinal column and ribs.

A slight groove appears down the middle of this plate. This groove deepens and finally disappears, because covered over on the surface and buried beneath as a hollow tube. This tube will remain hollow throughout life, but its walls will thicken and at the upper end will develop into the brain; the lower end will become the spinal cord. From the tube, outgrowths, or "nerves," will extend to all parts of the body.

At about the thirtieth day the embryo, to an uniniti-

ated eye, is not to be distinguished from any other mammalian embryo of like size. It has no limbs, but instead, tiny paddlelike organs not unlike the flippers of a turtle. It has a freely projecting tail. It has a pair of mammary ridges extending up and down its front side. These ridges disappear except at the upper end, where they form the mammary glands. But human adults with supernumerary mammary glands are not excessively rare. Adults with a freely projecting tail are rare, but are not unknown. A "tailed" human race is unknown—the monkey that evolved into an anthropoid lost its tail. But in assuming an upright gait, Man has not evolved a satisfactory natural defense against hernia.

At the time the fetus has a freely projecting tail and mammary ridges, it has nothing that looks like a human ear, nose, mouth, or eye—or anything human. It does have a curious pig-shaped body and a big head bent sharply upon its curious body. On the bend of that neck is a fish story of astounding dimensions. I can only suggest it.

That neck band has four depressions or grooves, called gill-clefts. Between the clefts are folds, called branchial arches. The embryonic neck circulatory system at this time also resembles that of a fish. The human fetus does not need gills; the clefts do not break through, but disappear, and with them go the arches. The real story is the changes which take place in these gill-clefts, branchial arches, and branched arteries during their development into the enormously complicated structures of Man's middle ear, mouth, and throat. That story is beautifully told in Keith's *Human Embryology,* and is more astounding than any detective story ever written.

For six months the human fetus is developing into something approximating a human being. In the last three months the fetus becomes more human.

It is not entirely human at birth. It has not yet the

adult proportions of size of head to body. The head is disproportionately large; the neck is scrawny; the arms are frail and puny; the spine has not yet acquired its human "S" curve; the legs are crooked and very short, and it can clap its feet almost as easily as it can its hands. In fact profound changes take place in its body before it is quite human. The characteristically human long leg is not fully developed until late in childhood.

With varying rates of growth, the boy will not have attained his full stature till after twenty-one, the girl till after eighteen—though there is great individual and ethnic variation. Why? Another long story formerly told in one word, Heredity, now in chapters with much about glands and their secretions.

There are many varieties and many millions of glands in the human body. In general, they play the same rôle in the large complex body that mineral salts or ions play in the small unicellular organisms: they hasten or excite or expedite chemical reactions. They may be compared to the enzymes or catalyzers of the digestive system. These enzymes are secreted by the glands of digestion, and, under appropriate stimuli, pour their secretions into the alimentary canal by means of ducts or tubes.

There are other "duct" glands: sweat, which help to maintain normal bodily temperature; oil, which moisten the skin and hair and lubricate the joints between bones; and mucus, which lubricate the alimentary canal—which otherwise would wear itself out from friction, for it is never still.

These *duct* glands contribute to the body's upkeep; they tend to keep the body as it is. Other glands regulate growth: the ductless or *endocrine* (secrete within) glands or organs. A few years ago nothing was known about some of them and little about any of them. Today endocrine literature runs into thousands of titles, and endocrinology has replaced astronomy as a thriller.

It is a thrilling story. A few grains of the thyroid secretion are all that stand between normal behavior and gibbering idiocy. With the epithyroids removed, death ensues; if they are deranged, fits (tetany) follow. Both are in the neck, just astride the Adam's apple. Below them is the thymus, which may have some regulatory control in early sexual development.

In the center of the head is the pituitary gland. It seems to be responsible for normal stature. Alteration of the gland leads to gigantism; or, if the alteration is in adult life, acromegaly results: the face becomes huge and ungainly, the hands become as large as small hams. Near the pituitary is the little pineal gland. Its function, if any, is unknown, but it is known that in our reptilian ancestor ten million years ago it was an organ of vision, a rude eye in the top of the head. The adrenal, just above the kidney, is another vital organ and of far-reaching influence. It will be looked at in the next chapter.

All these endocrine glands discharge their secretions directly into the blood stream and can thereby exert influence throughout the body.

The gonads (seeds), or sex glands (ovaries in the female, testes in the male), are concerned not only in the reproduction of the species; they also function as endocrine organs. Their "internal" secretions are responsible for the appearance of the secondary sexual characters. If the gonads are removed from the young male, he retains his ante-puberty characters: he develops no beard, Adam's apple, or pubic hair, and has no normal change of voice or sex impulse. Destruction of the female gonads causes physical changes which make her approximate the male in appearance.

That these endocrine organs exert a far-reaching influence there is no doubt, nor is there any question of the incredible potency of the secretions of some of them when released into the human blood stream or when administered as drugs. The potency of adrenalin

is really incredible; pituitrin is much more potent! Then, too, there is a far-reaching interrelationship among the endocrine organs. Excess of secretion in one causes change in the normal activity of others, etc. It will be many years before the details of these relationships are worked out. The astounding and gratifying thing is that so much has been discovered about them in so short a time. Diseases and abnormal growths which have baffled medicine throughout human history are now yielding to treatment; cures are effected daily which a few years ago would have been ascribed to miraculous power!

The story of the discovery of these secretions and of vitamins in the last quarter of a century is unsurpassed in human history in interest and importance, and in the hope it offers for the future of mankind; and is equaled only by the story of that other new biologic science, bacteriology. Both stories seem to favor the hypothesis here advanced that it is not human "intelligence" that has evolved, but human beings with curiosity to explore, great capacity to learn from experience, and great power to control their environment.

That this capacity is often dammed up in infancy so successfully that the adult remains a child is no valid evidence of the weakness of human nature or disproof of Man's infinite capacity to learn; it is proof that he has not yet made as much as he could of his nature.

Why? That opens up a large problem. But before we turn to it we must look at the problem of Man's somatic behavior as distinguished, so far as it can be, from his visceral and genetic behavior. How does the human body as a whole respond to the situations in which it finds itself?

CHAPTER FOUR

How Man Responds: Somatic Behavior

AS I write I move my arms; as you read you move your eyes. Arm and eyes are mechanisms which transform a specific kind of energy obtained from the combustion of physiological fuel. The physiological processes involved in these actions are not yet all understood; yet physiologists do not furrow their brows over them, nor give them up as insoluble, nor write big books over the vast Riddle of Writing and Reading. Psychologists do write big books over such Riddles. Our business in this chapter is to strip these Riddles of their antique verbiage and unscientific jargon and try to see them with the eye of observation and common sense.

But why should we want to try to solve the riddle of writing and reading and the other "R," or any other riddle? Whence comes my drive, impulse, wish, or *will* to write, and yours to read? A vast mystery is made out of this, and issues forth in such learned treatises as "Life, Mind and Spirit."

Human will is a mystery, as is an atom of hydrogen or a grain of salt. But the behavior of atom and grain can nevertheless be observed, and much can be learned about their behavior which can be put to use. Atom and grain are not simple, the grain less so than the atom: it exhibits a greater range of behavior, has more ways of cutting up; it is a more complicated structure, and has a larger repertoire of tricks, if you please; it responds to more varied stimuli. Mysterious, yes. It is a very great mystery that sodium (a caustic metal which bursts into flame and burns a hole in a

moist skin) and chlorine (a deadly gas) can combine to form a substance which is consumed by the human race at the rate of thirty million tons a year and without which there is no life. It is a mystery—but solved to the extent that salt is understood and can be made and unmade. So, also, can the mystery of the human will be brought into court and examined, and inferences can be drawn about it which are intelligible—and that is the business of every inference.

We cannot make a one-celled human embryo: it is not so well understood as salt. The chemical elements which enter into its composition are known, but only as the débris of what was an inconceivably complex mechanism. Its structural plan and its dynamic forces are not at all well known; they may never be fully known, but they will certainly be better known than they are now. Meanwhile we can make certain intelligible inferences from the known facts of the embryo's behavior. Can we infer that it has a "will"? Can we speak of its *psychology?* Well, there is no law against it, nor anything to be gained by it, for we have no way of knowing that it has a *psyche* or a "will." It does have its modes of behavior, it does respond to stimuli. How? What is its response? Depends entirely on the stimulus, as in the case of a grain of salt.

I may talk to the salt for an hour: it makes no response. I speak close to it, so that the moisture in my breath reaches it: it responds thus and so.

So, also, the young embryo. To certain stimuli it responds by breathing and eating—they were *vital* stimuli; to other stimuli, by curling up and dying—they were lethal stimuli. The result of one response was growth; of the other, death: a complex mechanism of a certain type and with specific capacities has now become a complex mechanism of another type; the specific organization whereby the mechanism could respond to vital stimuli has become another type of

mechanism—it can make no vital response to *vital* stimuli. Death has altered its *nature;* nor can its nature be reformed into life except as the molecules of its débris may be incorporated into and reformed within the body of a living organism.

This capacity or power to make growth-response to vital stimuli inheres in all living protoplasm. Call it "excitability"—a special kind of excitability found only in mechanisms so enormously complex as is living protoplasm. I can excite a grain of salt or a bar of pig iron, for they, too, are excitable, each in its own way, according to its nature.

Protoplasmic excitability is also of a specific kind, according to its nature. I excite an amœba with a pin point: it moves away. But the excitation (or stimulus) travels slowly across its body. The stimulus seems to slow up as it travels forward, as do the outward circles of waves when a pebble is dropped into a pond.

Note also that all portions of the surface of the amœba's body seem equally excitable by stimuli. All portions of your skin are not equally excitable. I reflect a ray of light on your neck—you do not sense it; that same ray on your eye is sensed—it is a stimulus, it excites or irritates you to action. The skin of your body senses light rays of only certain lengths—they are felt as heat; your eye is adapted for certain lengths of light waves and receives them as light.

Which means that the developing embryo will come to have special mechanisms or "organs" for receiving specific stimuli and in certain amounts only.

This brings us up against the most complex and the least understood of all mechanisms, the nervous system. But understand it in general we must; otherwise human behavior is black magic, psychic, and wilful.

That amœba, you will recall, has no mouth, no alimentary canal, no anus, no lungs, no red blood cells, no "cells" of any kind—for it is a one-celled organism;

yet it breathes, eats, digests, excretes—it grows. It has no legs, fins, muscles or cilia—it moves. Now, when one-celled organisms became many-celled organisms (or when the one-celled embryo became a many-celled embryo) certain cells took on special forms adapted to perform special work. Some cells specialized in the function of secretion—the glands; some in contraction —the muscles; some in carrying oxygen—the red blood cells; some in connecting tissues—the fascia; some in absorbing lime—the bones; and some to hand on the spark of life—the germs. What we are now to note is that other cells specialized to receive specific stimuli; still others to transmit specific stimuli.

To put it another way, certain cells assume the specific office of excitability and the transmission of excitations or stimuli for the entire complex compound organism. These cells form the sense organs and nervous system of the human body. They may be compared to a vast telephone system whereby our huge body (huge from the point of view of any one cell of our body) is integrated into a close-knit, unified, coördinated, organized going concern—a personality, a human being.

Note just what this means. If you cut a tiny sliver from the lining of my windpipe and pin it on a piece of cork and keep it moist and sprinkle a grain of dust on it, the cilia, or fine hairs, on that piece of my windpipe lining will move—they will try to move the dust upward. But their moving will not tickle my throat or cause me to cough. A ciliated epithelium has its *nature*—its range of behavior; as lining of my windpipe, its nature becomes part of my nature: its irritated state serves as stimulus to excite action in a mechanism which will remove the irritation—I cough. Action in one mechanism (cilia) sets up action in another mechanism (coughing); the nervous system was the go-between.

Through the nervous system, different parts of our

body are connected up with all parts of our body: our body can act as a whole and in behalf of the entire body.

A thorn in my foot leads to action in my hand. Cut the nerve leading from foot to central nervous system, I do not sense the thorn; cut the nerve from central nervous system to hand, there is no action in hand. Or the bottom of my foot may be so calloused that the cells modified to receive special tactile stimuli are beyond reach of the thorn; in that case there is no stimulus for nerve to transmit.

These "tactile" cells in the bottom of my foot are organs for receiving certain kinds of excitations; they are *receptors,* the "receivers" of a telephone system. The nerve leading from receptor to spinal cord is the telephone wire to central exchange. And right there the comparison must stop—for two reasons.

Your telephone wire will carry messages both ways —from your receiver to central, from central to your ear piece. But your nerves carry messages in one direction only, *toward* central or *from* central.

In the second place, the message you put into your telephone receiver is conducted to central or through central to some other party—and it is always the same message. But something always happens to a message from your sense receptor when it reaches your nervous system's central: it is put on to another wire, as a message for action.

Thus, pain-message from thorn in foot-receptor is transferred in central to action-message to hand: remove the thorn, the cause of the excitation. The receiving cells in foot were the *receptors* of the message; the motor cells in the hand were the *effectors* of the message. Hence, nerves from receptors to central are called afferent, or *sensory,* nerves; nerves from central to effectors are called efferent, or *motor,* nerves.

All of which seems simple enough—and is; but it is fundamental and it must be understood, or the rest

of this book is as fruitless as a dead apple tree. Which brings us to one of the most important hypotheses of modern times, alone worth all the speculations from Aristotle and Plato to James and McDougall.

All somatic or bodily behavior (the kind referred to in psychologies and not having special reference to physiological processes or the genetic history of the body) depends on stimulus in receptors and response in effectors, and functions through the central nervous system. No stimulus, no response; no central nervous system, no stimulus or response. Stimulus, receptor, afferent nerve; central nervous system; efferent nerve, effector, response: this is the renowned *reflex arc,* and all somatic behavior is effected through reflex arcs.

That seems simple also, but it is not so simple as it looks. For this reason: there are nine billion units (cells) in the cortex (bark) of the brain alone, presumably other billions in the remainder of the brain and in the spinal cord; *every cell is at least potentially connected with every other cell in the entire nervous system.*

Insult my child—auditory nerve carries stimulus of your words on my ears to my brain; what will be my response? Figure at leisure the possible permutations of these dozen billion central system nerve cells! Something will happen when that insult-message reaches my brain, but what my response will be, which part of me, which mechanism, will be directed by central to move, to effect the response and remove the stimulus, will depend on innumerable factors which for the present may be summed up in one word—experience. I may smile and nod my head in approval; you may have addressed me in Choctaw and it may have sounded to me like an invitation to have a drink! The point is, my response will not be instinctive or intuitive; it will depend on acquired or learned, not on innate, factors.

Every part of our body is a receptor; every part may

be an effector. My arm muscles are effectors at this moment, carrying out impulses from brain; they are also receptors, receiving fatigue stimuli from driving a pencil for nine hours on end. They are also receptive to heat and cold stimuli and to physical stimuli of pressure, as well as to chemical stimuli which they are now receiving and which make me tired.

We have special receptors, of course, groups or clusters of cells highly modified to receive certain kinds or ranges of stimuli: eyes for light waves, ears for sound waves, tongue and nose for chemical stimuli, spots in the skin for heat and cold and pain. Our skin is also thickly beset with tactile organs or touch spots, especially our lips and tongue. Viscera, muscles, tendons, and joints are also receptors of physical and chemical stimuli.

Special areas of the brain become "centers" where sensory or afferent messages are received. Every movement of my arm registers somewhere in central; otherwise central could not direct, through motor or efferent nerves, the movements which my arm is making. Every movement of my head registers in the balancing or orienting organ in my middle ear; otherwise some particular area of central could not direct effective action in muscles of neck and trunk to hold my head in position.

Messages from central are delivered to effectors: to motor mechanisms of striped muscles which work against bones acting as levers; to respiratory and circulatory centers which speed up or slow down action in the lung-bellow muscles, or increase or decrease action in the muscular heart or in the muscle-coats which regulate size of blood vessels; to glands which speed up or slow down rate of secretion of sweat, of saliva, or gastric juice, of insulin, throxin, adrenalin, etc.; to mechanisms of ingestion or digestion or excretion; or to glands or muscles of the urogenital system.

Add up all this, and we have a rough outline of a

human being: an organism which responds to vital stimuli or it dies. It receives vital stimuli through receiving, or sense, organs, it responds through responding, or motor, organs; the responses are effected through the central nervous system, the organ of adjustment.

Adjustment to what and with what? Roughly, adjustment to change in environment (without or within), and with change in the organism itself. Stimulus, response. The embryo responds to stimuli. How about the newborn babe? How does its central nervous system distinguish between vital and lethal stimuli, how does it know when to guide the hand toward or away from a flame? Or, more specifically, just what do we as newborn babes inherit?

The newborn inherits a specific bodily mechanism which can make vital responses to certain ranges of physical and chemical stimuli. And that is all. But in the very act of responding to these stimuli it grows, its parts develop, and its motor mechanisms especially take on enlarged capacities for responses.

The newborn cannot assume an erect posture, not only because it has not learned, but because at birth it has no erect-posture body. The newborn cannot put its finger in the cat's eye, not only because it has not learned, but also because at birth its brain center for such eye-hand coördination has not become organized. The child at birth cannot say "Mama," not only because its verbal mechanism is not well enough developed for such a performance, but because at birth there is no organized brain center to direct that mechanism to perform such a complicated act.

These motor mechanisms cannot respond until they are well enough developed, nor make learned response until motor areas of the brain cortex which control complex motor responses have become organized.

With developing arms and legs and trunk and neck, and with developing body in general, the infant's vi-

tality increases; it becomes more active, more energetic, because it transforms more energy and after the first year need not consume so much energy in mere increase in size, for it will never again grow so fast as it does the first year. After the first year more energy is available for somatic responses, as well as for sense organs which receive stimuli from the outside world.

After a few months, the child's energy available for new tryings-out and new experiences is very striking. It manifests itself in general as insatiable curiosity to explore, to manipulate, to try things out—with its hands, its eyes, its ears, its nose, its tongue. It fingers, looks over, listens to, smells, tastes, literally everything within reach, and cries for the moon. And the harassed mother cries: "Is there nothing that child doesn't want?" and the child would reply, if it could: "Nothing. Why not? I have never had anything; there is everything to have. I know nothing; I want to learn everything."

Why? It is its nature. Ages ago the injunction was laid upon animal protoplasm to explore its universe. Curiosity is as old as the hills. The amœba responds—it learns.

What does the infant do? What does it learn? It (or adult or fetus) is *doing* something all the time—its heart is beating and its viscera are eternally carrying on; otherwise it (or adult or fetus) dies. But what is its motor mechanism (or organ of locomotion) doing? Nothing in particular, both because it is not strong enough and because it knows next to nothing.

Here is a curious thing: mothers for ages have been going into raptures about their newborns—or complaining of one more mouth to feed, or frankly bewailing their lack of "graveyard luck"; but till recently it never occurred to anyone to look at a newborn as one would at a bacterium or a quartz crystal. What is it good for? What can it do? What is its repertoire of behavior? Viewed thus with the cold eye of science

(the trained and eager eye of natural curiosity), interesting and important discoveries were made, the newborn meanwhile suffering no discomfort and losing none of its alleged divinity.

What must the newborn be able to do if it is to live? It must breathe; it can. Excess of carbon dioxide in its blood excites the respiratory center in the brain. That center delivers orders to a very complex mechanism to get busy: the youngster shakes out its crumpled-up lungs as it inhales its first breath—an enormously complicated process, effected through reflex-arc route. That complex mechanism comes with every normal newborn, ready to function on orders from the brain when brain receives stimulus of excess of carbon dioxide. The parting of the placenta from the mother deprives the newborn of its means of obtaining oxygen or of getting rid of carbon dioxide. It breathes.

What next? Nothing of any consequence for a while; if the child is of a well-nourished mother, it has enough fuel (sugar and fat) of its own to keep it alive for a few days. But it also has a stomach which has a movement of its own when empty; we call it "growling." It makes rhythmical movements of a certain duration. These movements are carried to the brain by sensory nerves, as definite stimuli. What is the response to this hunger stimulus? "Food?" No, the infant cannot talk; it can cry—and will, if the hunger orders are imperative and if it can spare any energy from vital functions. Crying is hard work.

Suppose crying brings no food. It will stop crying for a while, because even a hungry stomach will tire and stop its growling—for a while. Then it will resume again. Will the newborn go get food? It cannot walk; but it can make simple restless, random movements with its arms and legs—and will, under the drive of an empty stomach.

Hunger is a fundamental drive—"wish," "impulse." Stimulus of contracting stomach results in action in

some motor mechanism; ringing a bell, going to the pantry, a shout, a cry, talking to oneself (thinking), or general uneasiness, nausea, or headache.

Suppose the child's cries and restlessness do not remove the hunger stimulus: it lives as long as its fuel holds out, until it has burned up so much of its vital organs they can work no more. It dies, and without great suffering after the first few hours. There is nothing heroic in starving to death.

But, ordinarily, before it has had time to cry or squirm under the drive of hunger, the nipple has been applied to the lips. That nipple stimulus will release action in another complex mechanism—the sucking reflex. A finger will also stimulate that action; the sucking mechanism knows no difference between nipple and finger, any tactile stimulus will set it off.

Milk in the mouth will stimulate another mechanism to action: the child will swallow the liquid—an extraordinarily complex act. But its stomach also is innately wise and acts on stimulus. Milk in stomach (but not water) is stimulus for another set of effectors to get busy: the glands of digestion begin to secrete. Eliminative mechanisms likewise are ready to respond to appropriate stimuli.

The point is that the newborn's visceral mechanisms are set on hair triggers, as it were, ready to go off when appropriate stimuli are applied. They function through the spinal cord and medulla oblongata, an enlargement of the cord just inside the skull. The great motor and speech mechanisms are dumb as dumb-bells. They know nothing and can do nothing but make random movements and sounds. There are no preformed organizations in the brain for talking (or thinking) or for using arms and legs. The movements the child will make with arms and legs, hands and feet, head, lips, face, and speech mechanism will depend on the movements it *learns* to make. These movements are *motor*

movements; they are not innate or instinctive, but are acquired and cultural in character.

This contrast between motor-mechanism *learning* and visceral-mechanism *knowing* is not absolute, but it is practical and it does furnish a sound and workable hypothesis for understanding human somatic behavior; and it is in accord with observed fact.

But it is not all of the story of the newborn's behavior repertoire. That youngster can be angered, scared, and pleased. Why shouldn't it? It is protoplasm, and protoplasm—especially animal protoplasm—has its "rights," its inherent nature.

The newborn gets mad, looks mad, and acts mad when its arms are pinioned or its body restrained. The key to animal evolution is *movement*. The newborn hates restraint!

The newborn becomes afraid, looks afraid, and acts afraid when it is dropped or jarred, as by a loud noise. Mementoes of life in the trees, dodging thunderbolts? We do not require that hypothesis. Consider again the nature of animal protoplasm. To drop it is to smash it. A baby or an elephant dropped from a great height would splash. An explosion could easily tear either asunder.

These hate and fear reactions of the child are innate in its nature, their visible manifestations are realistic and unmistakable. In hate or in fear, the child's very nature is altered, as is the adult's. The mechanism behind this changed nature is the adrenal gland just above the kidney. Its secretion in tiny amounts released into the blood stream induces far-reaching changes in the circulatory, respiratory, and alimentary systems, the net result of which is to withdraw energy supplies from the vegetative functions and make them available for the motor mechanism which does the fighting or fleeing for the entire organism.

The adrenal gland may be considered as a visceral "brain," ready in an instant to act in life-or-death

crises. Its potent hormone (exciter) *excites.* Under its influence one can fight or flee as under no other influence; the coward fights like a bull, the sluggard runs like a deer.

The complex mechanism driven by adrenal gland can form habits. Therein lies the importance of the discovery of its nature—for anger and fear are at the bottom of the stupidities of human societies. Once of great biologic usefulness (for our brutish ancestors were called upon to fight for their lives and to flee from their natural enemies), the emotions of hate and fear today are anachronisms, marring countless lives with eternal bickering, stultifying countless lives with their infantile fears and superstitions.

The third great *emotional* (or visceral) drive springs from the "love" mechanism. It is also responsible for the mate impulse or sex hunger. Or rather, sex hunger is responsible for the emotion we call "love."

Sex hunger, no less than food hunger, functions upon the workings of a definite mechanism, specifically the erogenous (love-producing) zones. But there is an important difference between these zones and the food-hunger mechanism. The sex-hunger mechanisms do not normally drive the motor mechanism to respond until the onset of puberty, at which time they come to maturity. Under the impetus of that new and specific hunger, the motor mechanism is impelled to action. The impetus or stimulus disappears when a mate has been found: the sexual act in itself is the response to sex hunger, as food is the response to food hunger. But the erogenous zones from birth onward are completely innervated and their delicate tactile organs readily respond to touch. They can be stimulated.

Note also that the skin of the body, especially of the face and lips, is thickly beset with tactile organs; their stimulation by caressing or gentle, soothing handling calls forth mild forms of generalized "love" re-

sponses. The fondled child responds with a smile or a coo or a gurgle.

We may say in general, then, that the infant will naturally respond with anger or hate to any restraining stimulus, with fear to any disruptive or explosive stimulus, and with love to any soothing or caressing stimulus—all biologically useful responses and innate in human (and higher animal) nature. They become conditioned into specific attitudes toward biologically useless ends, and into specific hates, fears, and loves, which are not only biologically useless but socially destructive. In short, the viscera acquire habits; they become organized along specific lines, get set in certain ways. The neurological foundation of the habit-forming capacity of the viscera is the conditioned reflex arc. The viscera become conditioned through experience.

"Conditioned" is no figure of speech; it is as real as the cortex of the human brain, as tangible as a nerve. When the great Pavlov demonstrated its workings, he furnished science with a working hypothesis for describing human behavior not less valuable than Newton's hypothesis to describe the behavior of the stars.

Recall again the newborn's inalienable right to get mad when restrained, to get scared when dropped or exploded, and to respond to a caress with a gurgle and a smile. And note that it has definite and tangible mechanisms through which the emotional states of hunger, pain, hate, fear, and love find an exit, and that the "states" themselves function through definite and tangible mechanisms. The "exit" may be a cry for food, a withdrawn hand, a clenched fist, a pallid face, or a smile; it may be a smile for an injury received, or headlong flight from a smile; it may be any of the inconceivable and incongruous acts imposed upon humanity by Man. The specific exit for any human being for any emotional state will be specific for that particular individual. The similarities of the exits will lie in the fact that our responding mechanisms—voice,

hair-raising, fist-clenching, smiling, blushing, loving, fleeing, eating, breathing, speaking, laughing, shouting, crying—are all made on the same general pattern and function through a similar nervous system.

When a few months old, the child can control its arm. Flame of candle stimulates its eye; the hand reaches out for the flame—and is burned. The burned hand acts as a check to further reachings out of the hand when the flame stimulates the eye: the hand has become "negatively conditioned" toward the flame. Now suppose that just as the hand reaches for the flame I bang a gong behind the child, or strike an iron bar a resounding blow, or explode a dynamite fire-cracker: the jar to the child's eardrum startles it; it exhibits a pronounced fear reaction. And thereafter the *sight* of the flame not only stays the child's arm, but makes the child *afraid!*

Again, no child is born afraid of, say, cats. It is six months old; it has never seen a cat. A cat is produced; it plays with it. But as the cat is produced some one from behind pinions the child's arms; it gets mad. Let this same performance be repeated for a few days: the mere sight of the cat arouses the child to anger.

Again. A child of two has not yet learned to be afraid of the dark. It enters a dark room and I grab the child tightly, at the same time slamming the door. In one lesson it has learned to hate and be afraid of the dark.

Again. A nurse each day bathes the child, fondling it, kissing it, stroking its erogenous zones. In a short time the nurse's face will elicit a love response from the child. If she wears a red dress each time, the red dress will soon become part of the child's conditioned love stimuli.

Result of these conditioned reflexes? Specific appetites, likes, dislikes, animosities, aversions, hatreds, loves, fears. Recent observations on several hundred

three-year children in New York City revealed the astounding fact that utterly incongruous things would in some children evoke smiles, in others anger, in others screams of agonized fear. The list of things which set off conditioned fear reactions, sometimes amounting to downright paroxysms, was a terrible indictment of ignorant mothers who knowingly or unwillingly resort to the conditioned fear route to make their children "behave."

Visceral drives exit through action in motor mechanism. It also becomes organized, takes on habits, learns.

This motor mechanism is primarily bone and striped or "voluntary," muscle—which means that it is not innervated by the same set of nerves which control the smooth, or "involuntary," muscles of the viscera. They have their own nervous system (the "involuntary," including the sympathetic); the bone and muscle mechanism functions through the spinal cord, but the great centers of coördinated control are in the cortex of the brain. The "involuntary" system can, of course, "talk" to the brain—otherwise we should not know when to go in or out of the rain and when to pray for rain, or which ticket to vote, or which girl to make love to.

Going in out of the rain, praying, voting, making love, are done with the motor mechanism functioning through the "voluntary" nervous system. I have no idea what is meant by "free will"; I do have an idea that willing and wishing are the same thing and function through the voluntary nervous system when the involuntary system gives the signal. The protests which will be made that I am "robbing" life of its nobility, etc., will spring from conditioned visceral states and will exit through the mouth.

And therein we have a valuable clue to the dual rôle of motor-mechanism activity: it performs through arms and legs, hands and feet, head and face, shoulders and trunk, etc.—that is, through action of muscle on bone; or it performs through the complicated voice

mechanism of lungs, throat, vocal cords, mouth, nose, teeth, tongue, and lips. This voice mechanism (or organ of speech) is in part motor mechanism and in part viscera. It is primarily, however, a segment of the motor mechanism. Response to my "idea" might be expressed by a frown, a sigh, a shrug of the shoulders, a blow of the fist; or by a malediction which could be written, spoken, or merely "thought." There was a time, and it may come again, when the response would be a curse and the torture chamber.

The point is that somatic responses are made with the hands (using "hands" as a convenient short cut to all activity in the projicient apparatus) or with the voice. Also, of course, in glands, blood pressure, respiration, etc., etc. But we are here concerned primarily in the larger, more general, and more easily observed responses which for convenience we speak of as somatic.

The newborn has no organized manual behavior, no organized verbal behavior. It cannot walk to the dinner table, it cannot say, "When do we eat?" It learns.

The motor mechanism is frail and puny at birth. Not for several weeks are the arms and legs strong enough to become really active. Not before the child can walk is it a really going concern. The response with hand to stimulus of candle flame to infant's eye is at birth no response at all—the flame was no stimulus. But gradually the eye itself becomes a stronger mechanism for receiving stimuli, the hand itself goes increasingly faster toward the object which has stimulated the eye. Centers in the cortex of the brain which make possible this so-called eye-hand coördination, come into operation. But the little arm has made countless fruitless and random reachings forth before this coördination center can so function that the child finally reaches for the flame with "unerring" aim.

The hand is burned, and in one performance has learned a lesson it will not soon forget. Some of these

early experiences are so burned in that the lesson is learned for life. There is a neurological foundation for all somatic behavior. We can become skillful performers without "minds," but without nerves we are paralyzed.

That burned hand may be taken as typical of the entire process of learning—of training, of education. Stimuli, countless stimuli, soon begin to beat upon the child's own quickening senses; the responses these stimuli evoke will depend on the responses already made.

The infant, let us say, has learned to reach for things it sees. Thus far the little hand has had no alarming experience: to reach, to grasp, to handle, has yielded satisfaction only—the satisfaction of having "obeyed an impulse," the satisfaction of muscle tonus or feeling of well-being which accompanies action in healthy muscles, and the satisfaction reflected in parents' faces and in their patting actions as reward for the pleasure they feel in noting the growing powers of their young hopeful.

Then the hand grasps the flame: it will not reach out for a flame again soon; the burn may be so severe that the hand will reach for nothing for hours or even days. We say, "The child has learned," and so it has; it is even more correct to say that the coördinating centers in the brain have "learned"—they have acquired a new "set." The old reflex arc, "stimulus to eye, reach for with hand," now becomes specific for flame; "*flame* stimulus to eye, withdraw hand!"

For "flame" substitute a box on the ear, a slap on the wrist, or a terrifying shout—as when the child reaches for father's watch!

In such manner and through such nervous organizations the child's body, as it grows in size and strength, becomes organized. Call it *kinæsthetic* organization. The newborn's motor mechanism is not organized at birth; it can do next to nothing. It does become so

organized that it can do countless things. That organization is possible because the central nervous system is eternally receiving messages, from muscles, joints, tendons, ligaments, and from the orienting or balancing organs within the middle ear. Central, if you please, comes to *know* where the hands, feet, and trunk are, and where the head is. This kinæsthetic organization becomes so perfect that a cat with its brain removed will right itself if dropped back down—it will land upon its spread feet! Kinæsthetic organization, acting through spinal cord reflex arcs.

Little more need be said as to the organization of the child's manual behavior. Banging the rattle on the crib is good practice for learning to drive a nail, and that for learning to drive a tennis ball. This body that came to us from the trees is marvelously beset with sense organs and marvelously innervated. Our capacity for agility in general and for manual dexterity in particular is not new with Man; it had a long and honorable career through the forests and in picking the good things out of nature's larder. What the hand will pick at the age of ten or twenty or fifty—whether some new secret of nature which will benefit mankind, or some one's purse or happiness—will depend on what that hand has learned to do and what has been the drive behind it.

The organization of the child's verbalized behavior, because Man is a talking animal, is equally important. As the hand can be taught any trick, so the voice mechanism can learn any language. It can become "clever" with its voice, as it can with its feet or its hands or its face. If its vocabulary is large and well learned, it can manipulate the objective universe, or this or that part of it. It can explore the Amazon, climb the Himalayas, cross the Sahara, play golf, build towers, tunnel rivers, and solve the riddles of Sphinxes and of the universe—in words. It can write the words, say them aloud, or think them,

Add it all up and we have: visceral apparatus ready to function at birth but also ready to acquire habits—as, for example, when and what to eat, when and at whom to smile or frown, etc.; motor mechanism, frail, utterly unlearned and incompetent at birth, but soon strong enough to begin to learn by trial and error. Within three years the child has laid the foundation of its personality: its viscera have acquired habits; its organs of locomotion and speech have learned important lessons; it has got well started in its emotional, manual, and verbal organizations. In short, it has learned the first great lessons in *human* behavior.

The visceral central consists of spinal cord and medulla oblongata; if they are not in working order, the child (or adult) dies. Spinal cord and medulla are the *living* brain. The motor mechanism central consists of cerebellum and cerebrum (little brain and brain); if they are absent at birth the child can live, but it can never learn to recognize its mother's face, or say her name, or reach for a bottle, or walk a step. Cerebellum and cerebrum are the *learning* brain. The living brain is born wise; the learning brain is born dumb—but it is nineteen-twentieths of the entire brain!

That proportion of inborn learning brain to living brain is the key to the nature of Man. Man is born ignorant; he can learn anything. He can learn so well that he can become a bundle of habits.

Human behavior is not instinctive behavior. Man needs no instincts because his nervous organization is such that he can learn—learn so well that his learning (kinæsthetic organization, manual organization, verbalized organization) can be exhibited as though it were instinctive; it has become a habit.

Do we forget? There has been much mystery about forgetting—and memory. There need not be. We do not forget how to walk; we learned that lesson well. Millions and millions of brain cells are at work coordinating movements in muscles in every step we take.

The coördinating centers in brain get set: stimulus is followed by response; response becomes stimulus for next response, etc. Injury to that coördinating center in brain cortex washes out the response. Or disease may slow down the response; long disuse may wash it out entirely.

We "forget" a name, let us say; we cannot "remember" it. Either the stimulus is insufficient or inadequate to call out the response or the name was not learned well enough to be called out by mere fumbling with names. To "remember" something we have learned is to do it again—to play a game of tennis on a tennis court, or to talk or think tennis.

Some acts or performances we learn with both manual and speech mechanisms—and early performances up to three years of age generally without parallel verbal organization. We cannot talk or think about them nor do they exist in "conscious" or "unconscious" "mind," nor are they "repressed" to be called out in "psychoanalysis." We do not "repress" youthful immoralities, etc.: we simply do not repeat them in talk or think about them. Were the situation to be reproduced in which they originally occurred (that is, similar stimuli), the manual or verbal or visceral organization would again respond, or would not respond if the original learning had become so overlaid with other learning that the neurological foundation had been washed out.

Things learned with emotional attachments are especially persistent. The visceral mechanisms, through their autonomic nerves, learn and form habits which can persist for life—or lie dormant for years, to reappear in second childhood because the habits of middle age are laid aside and the well-learned habits of childhood can get a chance to exhibit themselves again.

Stimulus and response, stimulus and response, stimulus and response. Or, if you please, situations and deeds—a sigh, a prayer, a blush, a frown, a poem,

painting, a call to arms or to dinner, a blow of a fist, a shrug of the shoulders, a new dress, a new razor, a trip to Paris, a fit of the blues. A broken shoelace can set up action in a thousand glands and a million muscle engines, change the position of and action in all the viscera, and release action in manual and verbal mechanisms.

Where does the "mind" come in? Merely as a figure of speech for the various forms of verbalized behavior; otherwise, as a mysterious "soul" under a different name.

Man, amœba, pig iron, and hydrogen atom may have minds, and if so, they may have also an unconscious mind. I cannot prove that they have no mind. I can say that their behavior can be better understood on the hypothesis that "mind" is a pure superstition. That hypothesis is biologically sound, accords with observable facts, and is a scientific and commonsense inference from observable facts. And may it be insisted upon further that any hypothesis or theory unsupported by anything within range of observation or not warranted by observed facts, is unscientific and, for purposes of advancing and understanding the nature of things, is potentially dangerous. The spirits, souls, minds, devils, demons, gods, angels, fairies, creators, causes, etc., etc., invented by our ancestors to solve mysteries with words and explore unknowns from a seat around a camp fire or in the seclusion of a cell, are fossilized excrescences from a childish past and are as useless as is a vermiform appendix to the intestine or a persistent foramen ovale to the heart. The appendix may be fatal, the foramen generally is. Unsound and unscientific hypotheses are not less obstructive to the acquisition of norms of biologically sound behavior. The "mind" must follow the soul into the scrap heap of worn-out and useless relics of an ignorant past.

There is a neurological foundation for human so-

matic behavior. The discovery of that foundation is a modern achievement and has revolutionized our knowledge of human beings. It has brought human behavior in out of the fog of the misty past and exposed it to the eye of observation.

The attempt has been made in this chapter to set forth this neurological foundation in outline. Attention has been especially directed to Man as a peculiarly complex mechanism which responds to certain stimuli or situations with certain responding mechanisms; as a being which is impelled by smooth muscles or visceral mechanisms, and which in responding with motor and speech mechanisms becomes conditioned by society and thereby learns from experience. In other words Man is *moved* by his *emotions* (food and mate hunger, thirst, anger, fear, pain, etc.,); but the movements he should make depend upon custom, for certain movements only are good manners. His biologic necessities must be socialized in the school for human etiquette. He must learn to behave like a member of society.

To that side we now turn. Who is the teacher? Who trains this neurological foundation to acquire specific forms of human behavior? We have isolated Man from his family for our convenience only; he must be restored to the human society into which he is born and whose ways he must learn. What is the nature of human society?

CHAPTER FIVE

The Family Situation: Social Behavior

TO say that Man is a Social Animal is to say nothing more than can be said of any other Primate; to label human behavior with the phrase "Instincts of the Herd" is to cloak the problem under a meaningless phrase—it is like saying that Man survived because he was fit. Fit for what? For survival. Survival of the survivors gets us nowhere. Every human being, and every monkey, for that matter, is born into and automatically becomes part of a family which will condition his responses. That family will condition the responses of the growing child, the child will form a fundamental part of the social environment which will stimulate the child to respond and which will condition the responses it learns to make. The character of the family organization will be an important factor in the conditioning.

The essential difference between human society and ape or monkey society has come through speech. The ape's brotherhood is limited to the number of apes he can learn with eyes, nose, fingers, etc. Man limits his brotherhood by names and phrases which through early conditioning become as potent in determining his attitudes toward millions of human beings as though he knew them by his eyes, ears, and nose.

Unfortunately, his "brotherhood" phrases do not prevent him from warring on his brothers; one compartment of his learning (the verbalized) does not necessarily control action in the other compartment (the manual). The real danger in such phrases as "social animal," "survival of the fittest," "instincts of the herd,"

"yellow peril," "Christian virtues," "making the world safe for democracy," etc., is that they mask ignorance. The ignorant make weapons of them to hide their ignorance, and close their eyes to observation. Their pride in such weapons is merely pride of ignorance, the deadly enemy of freedom.

The key to human behavior is stimulus (or situation) and response. Our problem now is to see how the "family" becomes the stimulus (the *social* environment) and how the child learns to respond to the family.

The infant's vital mechanisms are ready to function at birth or shortly thereafter. Through the working of these mechanisms it can prepare its own fuel and building blocks, and can blink, sneeze, cough, vomit, eliminate, and cry, and can be angered, frightened, and soothed. Its motor mechanisms are quite ignorant or "imbecile." But it also has parents, a mother at least, or some one who mothers it. "Motherhood," among all animals, involves a certain responsibility for the continued existence of the race or species; among mammals, the mother is responsible. True, there must be a male parent also, and among higher mammals fatherhood generally spells protector, guardian, and helper. This is especially true of the great order of Primates, highest of all animals and including Man (*Hominidæ*) as one of its six "families."

This motherhood and fatherhood function gives us the biologic foundation of the *unit* of all human societies or social organizations. That we in our day have traveled far from this primitive unit no more discounts its natural foundation than does woman's love for dogs discount the biologic nature of her mate impulse—it just repudiates it.

There is a "natural" family. That family consists of parents and offspring—and, even among apes, of grandparents, uncles and aunts, and cousins. The delimiting boundary of a chimpanzee "family" is not,

however, strictly blood relationship, but rather mutual acquaintance. Do they *know* one another? Are they on "speaking" terms with one another? If so, they belong, they are friends; if not, they are outsiders, potential enemies.

This concept of "family" or primitive social group undoubtedly holds good for early human society. In fact, it is so founded in human nature that it holds good for the majority of the human race today.

Animals as highly organized (nervously integrated) as apes and Man have great individuality. But family relationships—mates and offspring—imply surrender of a portion of that individuality. And that is what happens in courtship and mating and in bearing and rearing children. Each finds his or her fullest individuality only by surrendering part of it. To put it another way, the motor mechanisms can make adequate response to visceral demands only by joining others in playing the game. So far as the species or race is concerned, it is not enough to live—one *must* live socially.

Hence social behavior or family life not only has a visceral background; it has, among Primates especially, an evolutionary background. As Professor J. Arthur Thomson puts it, a certain amount of altruism came to have great *survival* value in ape and primitive human society. Families hung together or perished individually. The male protected the female, the female nourished the offspring, and the offspring learned the ways of the parents, or the race perished. The very acts of mating and protecting, of gestating and nourishing, and of teaching and learning, imply close relationships, intimate acquaintances, common enemies to be killed or avoided, and mutual loves—an altruism as wide as was demanded on biologic grounds and prompted by social requirements.

It need hardly be said that this family was naturally a one-wife, one-husband family, and that Man by nature is no more polygamous than is woman polyandrous.

Polygamy and polyandry are innovations in human society—as are infanticide, prostitution, celibacy, homosexuality, autoeroticism, and other sex psychoses which are as barren as vestal virgins and biologically as useless.

This close and prolonged intimacy of family groups naturally gave rise to what we may call the family complex. By that, nothing mysterious or "psychic" is meant; simply, a biologic unit. The going concern in primitive society was not the head of the house but the house itself. Not that the house always acted as a unit, not that at times it did not war upon itself, but that in general the family did act as a unit, and had to act as a unit or act unnaturally.

With the development of speech as a means of communication, and especially as a definite tool for naming objects, human social behavior entered upon a quite new career, the end of which is not in sight. Language was the turning point in Man's break from the apes; its origin was from such vocalizations as apes and monkeys make.

Apes can communicate information to one another—how well can be learned from the pages of Dr. Wolfgang Koehler's valuable book, *The Mentality of Apes.* But the information is all emotional—dangers, foes, enemies, friends, food, screams of rage, distress, and abject fear, whines of teasing, scolding, and petulance, and the soothing, cooing, billing of affection and love. Within their repertoire of emotional cries, ranging from the passion of love to that of rage, they are marvelously clever at performance and in understanding. But not one single *word* as a *symbol* or a *sign* for a concrete object, act, or relation. Just why they do not talk, no one knows. Perhaps adequate stimulus to learn to talk has not yet been offered to them. At any rate, it is not known that a chimpanzee or a gorilla could not learn to speak enough words to pass a simple "intelli-

gence" test, especially as nobody knows anything about intelligence.

Talk "intelligence" over with yourself and see what you can make of it, always keeping your feet upon the earth. No ape can do that, nor any child until it learns. It may so learn the word "intelligence" that it will be awed when confronted by some individual said to "possess" great "intelligence."

And in such fashion are *words* learned. A voice evolved as a mate-cry comes finally to such perfection of mechanism that it can run the gamut of emotion and pronounce all the words in the dictionary. But some words will be learned under emotional strain: merely to hear or to utter them will stimulate the release of adrenalin, or evoke a sigh, a smile, a tear, a groan, a shudder, a clutching at the heart, a gripping of the throat.

The newborn, as we have seen, acquires specific ways of behavior, learns to handle a dictionary and read the words, learns with its hands to make a dictionary stand, and with its voice to invent new words for the next dictionary; learns to love some words, places, things, faces, and situations, and hate or fear others. As the capacity of the human race to acquire new ways of somatic behavior was reached when ape-man definitely became Man and has not been enlarged since, it follows that any normal newborn can learn anything. What it learns depends on what and how it is taught, and not on the color of its skin, hair, or eyes, nor on the shape of its head, face, nose, and ears, nor on any physical trait whatsoever, of itself or of its parents.

All human history proves this. Further, no so-called mental, moral, or intellectual trait, character, disposition, talent, bias, bent, taste, or genius has ever been proved to be innately associated with any race or physical type or with any specific color of skin, hair, or eyes, or shape of head, hair, face, eyes, nose, chin, or ears, with any physical trait whatsoever.

Every character and every genius in history—Buddha, Elizabeth, Napoleon, Lincoln, Phidias, da Vinci, Newton, Darwin—apart from time and place, apart from physical and social environment, is incomprehensible.

This social and physical environment (parents, cradle, roof, street, nurse, relatives, friends, community, nation, position, schools, etc., etc.—in short, time and place) is specific for individuals and so complex and so intricate that it can never be the same for any two human beings on earth, not even identical twins! To this environment comes the newborn babe, with boundless capacity, infinite curiosity. From the day of its birth to its death in old age, its natural impulse to live is met with: Live this way! It is conditioned.

This impulse takes fairly definite and specific directions: throughout life, food, air, etc., and protection from or avoidance of extremes of heat and cold and all noxious stimuli; throughout adult life, a mate or mates. This general impulse becomes specific in myriad forms—as numerous as ways have been found to satisfy innate food and mate hunger, and protection from noxious stimuli. These "ways" could not have become so numerous in millions of years had not Man duplicated his objective world with a word world which he could carry under his hat and manipulate at his leisure with no great effort or expenditure of energy. This word world could not have assumed the importance it has, had not Man conditioned it with specific hates, fears, and loves.

This word world is, of course, of inestimable value in short-cutting action, thereby saving time and energy. Human culture is inconceivable without this short cut to human knowledge and human activity. What is not so obvious is that much that passes for great thinking is, when examined without visceral attachments, nothing that can be put to work, nothing that can be brought within range of human observation, nothing

that is related to the factual world in which we live and die. Words, phrases, poems, speeches, slogans, formulæ, we carry with us by the score; they move us —to tears, to laughter, to derision, to scorn. That is the way we learned them—emotionally; to hear or to say them again is to be moved. That is what emotion is for: to move us to fight or flee or possess. Result, entire nations fighting for possession.

Of what? Goods? Slogans, words, phrases!

Mob mind, mob instinct? No, simply social conditioning, increased stimulus, and thereby a different response. If the coward's adrenalin does not drive him over the top with the crowd he succumbs to shell shock, and is thereby socially adjusted.

Given society as it is, then, with its accumulated load of acquired appetites, fears, hates, and loves, it is hardly to be wondered at that so few have risen above the mass, or that human culture still condemns its millions to the hells of its own creation.

The "family" constitutes the social environment situation to which the developing child learns to respond —with word or deed and backed by more or less emotional drive. Society, to use a figure of speech with a neurological background, lays its conditioning hand upon each member born into it. It makes strange demands at times—and through the conditioned reflex mechanism gets the responses it demands: a pain stimulus finds its exit as a smile, a pleasure stimulus finds response in sackcloth and ashes.

One net result of these early-conditioned, emotionally-driven responses is that the child's innate curiosity is soon circumscribed by walls beyond which it learns it dare not try to tread. The "dull" child in school may be physically deficient—undernourished, etc.; it is quite as likely to have been so dulled by six, eight, or ten years of "Don'ts!" that nothing short of complete change of social environment and patient reconditioning would restore its inherited right to explore the

universe. Teachers also can do their part in dimming eyes and muffling ears that were evolved to see and hear, and in choking voices and tying hands that were evolved for shouting and playing.

The home, the street, the church, the school, the club, the community, all have their more or less potent hand in fashioning the growing child's ways, in saying what the child can and cannot do, what it shall and shall not do. And what will it do?

You must answer that question yourself, for you are at once the "child" and "society." It depends on many factors. A little effort will soon prove fruitful in analyzing these factors. Psychoanalysis is not half so mysterious as it sounds; nor mysterious at all if for "psyche" you substitute a human being who has to do certain things to keep alive, but can learn to live in a thousand different ways. And each way will have its own history; knowing that history, each way will appear, from the standpoint of the individual living that way, as *normal*. Disregarding those structurally deficient at birth or deformed through drugs or disease, there is no criminal or insane "class." Criminals and insane are graduates of "schools" which fit pupils for criminal or insane behavior. And we, as "normal society," accept them as normal products and finish with our duty when we condemn them. Even a dog must be pretty old that cannot be taught new tricks.

In other words, we can understand no human character without knowledge of the environment in which that human being grew up. It learns; it can learn anything. But what was there for it to learn to do, what was its available "universe," and especially what was the result day by day of its explorations? Darwin's innate curiosity was encouraged, not dwarfed; he explored the world of life as no other man has explored it.

The child of the tenement garret or the slum cellar meets one range of stimuli to invite its curiosity, to

draw out its activities, to develop its talents; the child of the moors or forests or wide-open spaces meets with a different range of stimuli. And every child, whether of hovel or palace, city slum or country cabin, grows up as a specific stimulus to its parents. The stimulus of first-born in a household is a different stimulus with the tenth child. The parents themselves change with age and with fortune; they can never be quite the same parents to all of their children.

Conceivably, had a certain wandering star passed the sun a few miles further away, this earth would not have been torn from the sun and the complex molecules of our bodies would still be small molecules of simple elements in the blazing sun. There are times in the life of the growing child when seemingly quite insignificant factors take on fateful rôles. The ridiculous little mouse gives birth to a mountain!

Acquire. That is the key to human social behavior: to learn, to form habits, to get set in specific ways, to build cultural traits upon plastic, uncultured human infancy, to acquire new modes of behavior to meet change, to answer change in situation with change of behavior.

Changes in situations have led to changes in responses throughout human history. The family grew larger; the situation again changed. Man's nature did not change. But the situations to which he responds today seem infinitely remote from those to which our earliest human ancestors had to respond with their naked bodies and empty hands. The history of civilization is the history of changes in situations and the responses thereby evoked. To that history we now turn.

CHAPTER SIX

The Rise of Civilization: Cultural Behavior

FOXES have holes and birds nests, but Man, having no place to lay his head, built himself a bed. His nature demanded it, his ape ancestors were accustomed to it. Biologically speaking, a red damask bedspread is just as much part of Man's nature as a honeycomb is of a bee's. The bee must build its comb of wax; Man can make his bed in ashes or of iron, or learn to sleep on the floor. The bee is a creature of instincts; Man, of whims. The bee is limited by its innate nature; Man's innate nature knows no limits—otherwise civilization could not have been born.

Once there was nothing that could be called civilization, nothing even approximating the culture of the most primitive tribes known to history. This must be so because once there was no Man on earth. Turning back the pages of the book of nature written in the earth's crust, we pass through successive layers of culture. The deeper we go, the more primitive becomes the culture; and at last there is nothing at all that can have been made by human hands. Why culture at all?

Man must have food and protection. The food part is obvious. The protection part is not at first so obvious. It will be if you recall the fact that when Man appeared on the scene, the "scene" was beset with wild animals. Noah's Ark was at large, and not a single animal had yet been trained to jump the hoop or pull a plow. To lion and tiger, elephant and buffalo, crocodile and snake, our earliest ancestors had no answer but their bare hands and naked feet.

They had no stone knife or hatchet, no bow and

arrow, no spear, no blow-gun, no sling, and no shield. They knew nothing of fire or of firearms. They had only a scant hair covering, and no shelters but natural caves. They had to travel on their bare feet; they were indifferent swimmers, runners, and climbers. Their teeth were good for nothing in particular, neither for any special diet nor for weapons of offense or defense. Their physical prowess may have been that of a chimpanzee; it could not have been that of a gorilla—for when they branched from the ape line they went in for big brains rather than for big chests, powerful arms, and jaws strong enough to crush a gun barrel. With a highly organized and delicate skin, they suffered the thorns of the flesh and the sting of cold. And because of the helplessness of human infancy and the length of human childhood, they required protection and shelter.

Their wits were their greatest asset. Had they not put them to work, they conceivably could not have survived at all. They did put them to work. Human culture was the answer. It came painfully, slowly. Then, as now, Old-Man-Afraid-of-Himself was a creature of habit. But he had to develop new habits before he could overrun the earth and found homes in Tierra del Fuego and the desert of Sind, and on coral atolls and among the Himalaya Mountains.

But suppose the scene upon which Man came had had no flint, no iron, and no hoofed animal—no elephant, pig, horse, camel, llama, reindeer, ox, buffalo, sheep, nor goat, no ungulate of any kind—and no birds. This might have been such an earth. It would have been quite a different Home of Man, and the entire course of human culture would have been different. Human culture has human nature behind it, but it is what it is largely because there was flint, there was iron, and there were ungulates which fed, clothed, and carried Man, and drew the chariot of civilization.

The Bantu of Africa, for obvious reasons, do not build snow houses; it is not so obvious that the Amer-

ican Indian did not invent a saddle because he had no horse, and no oxcart because he had no ox.

In other words, this world in which Man evolved was not the moon or Mars or Venus—it was a world of certain specific gravity, of certain atmospheric pressure, of land and water areas, of rivers and lakes, valleys and mountains, of deserts and forests, and of certain natural resources of soil, rock, and mineral, of plants and animals, of natural friends to be won and natural enemies to be evaded or destroyed. It was, in short, a thus-and-so world which beat upon Man's senses and to which he had to make living responses.

Life was then, as it is now and ever must be, eternal adjustment to environment. The history of human culture is the story of that adjustment. That history never repeats itself because the environment itself changes and because Man himself invents new ways to adjust himself to change.

Man in his childhood reached out for the first thing handy. Therein is the key to the material or manual side of human culture. As an ape, Man was handy with his hands—more so than any other animal. An ape will use a stone to crack a nut or to throw at an enemy; it will use a stick to dig or to reach with, or to hurl at an object. Early Man could not have been less handy. He became a user of tools, but he never invented one so clever as his hand. Human culture is inconceivable without human speech; it is also inconceivable without human hands. The hand grasped the idea spoken from the mouth.

Those first steps in human culture can only be guessed at, their sequence is not yet known. There are no fixed dates for the first appearance of this or that step. We can look at those which were of far-reaching consequence.

First, fire, known to Man a hundred thousand years ago. How discovered or how first made is unknown. But with fire Man had made a great conquest over his

physical environment. It is an enormously useful tool, a huge labor-saving device. No one step in human culture, speech aside, was so important. The method of artificial production by friction once discovered, Man needed never again to go without a fire. It made the outcome of his struggle for existence more certain.

The hearth became the center of family affection, the foundation of the home. It stimulated Man's imagination as did nothing else. It entered into all his activities, into his dreams, his tales, his religion. He idolized it! Around the hearth was the home: the shelter of a cave, a lean-to of boughs, a thicket in the forest. Hearth and home—respect and veneration for one, pride in and love for the other.

Slowly through the ages the trappings, furnishings, fittings, ornaments of the home grew in number and importance, while the home itself played an increasingly variegated part in stimulating Man to new efforts in different directions. From rude shelters to vast palaces for the living, from rude shrines to huge temples for his gods, from shelters of boughs and holes in the ground to towering pyramids and costly mausoleums for his dead. Protection for his body, for his gods, for his dead, and for his animals, tools, business, games. Protection from the sun, from rain and snow and cold and against his enemies.

With a fixed abode, a roof above hearth and bed, human culture took a new bent. The old incentive to wander forth to pastures new gave way to effort to maintain "pastures" about the home.

When an orang has eaten all the fruit near by, it abandons its nest and builds a new one in another quarter—as did early Man. But a fixed abode with sentimental attachments, including a family burying ground, could not so easily be abandoned. But food there must be; the domestication of plants and animals was the answer.

The fascinating story back of this great triumph of

early Man over his physical environment cannot be told here—nor is it all yet known. But it is known that the technique of taming wild grasses and fruits and animals was utilized in different regions and at different times; and that with the possession of a dependable crop of grains and fruits and a steady supply of animals fit for food, transportation, clothing, and utensils, human culture took another great step forward and Man's immediate future again was assured.

With domesticated plants and animals came innumerable tools and implements, the development of trade and commerce, new methods of locomotion and transportation, and new methods of war, conquest, and the expansion of early roving family groups into tribes living in permanent villages. All this made for extensions and revisions of the entire machinery of social organization—rulers and ruled, laws, codes, government, etc., etc.

Second only in importance to the invention of fire-making apparatus was the discovery that flint could be chipped into axes, knives, daggers, arrowheads, spearheads, scrapers, awls, saws, hoes and even razors. The uses to which early Man put flint, the labor he put into working flint, and the amount of flint actually handled, are almost incredible.

Why? Because flint, when struck, has the unique quality of splitting with a conchoidal fracture; it "chips." The fresh chip can be as sharp as a razor! The first great steps in Man's conquest over environment were cut out with flint tools and flint implements. Fire was the center of the early home, but flint dug its foundations, hewed its wood, quarried its stone, and protected it from prowling beasts. There are few craftsmen today so skillful in their handicrafts as were these ancient workers in flint. Their "gold" mines were flint quarries.

The domestication of plants and animals resulted in vastly increased control over environment. Now note

what resulted when Man found almost ready-made for him such a variety of serviceable tools, implements, and weapons as could be had from flint. With knives and axes he gained new and enormously increased powers over both animal and plant worlds: control over the woods of the forest, the hides and carcasses of animals, and the treasures that were hidden in the ground. He could dig, he could fell, he could build, and he could fashion things into numberless forms.

But more than that. With his flint-tipped spear he commanded a dagger more potent than the saber-toothed tiger's fang. With bow and arrow he could take aim as deadly as the cobra's and shoot his poison-tipped arrow into the lion's den or up to the eagle's nest, or drive it through his enemy's heart a hundred yards away. His hand was a tool, but it had now become a weapon with an even deadlier bite and a flight more rapid and far-reaching than any Nature had produced in the animal world in a hundred million years. Only the forces of nature—sun's rays, thunder's bolt, sea's rage, volcano's fire, earthquake's heave—could outdo these Man-made extensions to human hands. They were to the dawn of civilization what telescopes and microscopes are to modern science, extensions of human powers to conquer time and space, and to bring the out-of-hand and out-of-sight within reach of human hands and eyes. Man's greatest conquests were made with flint and fire.

Further narration of Man's early conquests over his physical environment is here unnecessary. That story has been told again and again, and with new discoveries from year to year, in more and more detail and convincingly. There are disputed points, obscure points, and gaps in the story; there are great areas yet unexplored, strata or levels not yet correlated. But the story is known in its broad outline and is easily available.

There is another side to this story of Man's early

conquests over nature, sometimes called the Spiritual or Intellectual (including the "higher life" of so-called Fine Arts, Literature, Ethics, Æsthetics, Religion, and Philosophy) to distinguish it from the material. But "spiritual" implies spirits and "intellectual" implies intellect, and while both are fit subjects of investigation, neither is within reach of the eye of observation or the inference of science. We must find another term to describe these human responses. Material culture is hand-made culture; "spiritual" or "intellectual" culture is voice-made culture—and without human speech impossible.

It need hardly be pointed out that ancient Man, as modern, responded to many situations with both hands and voice, and with emotion. The throng passing the Glorious Dead cenotaph in Parliament Street responds with hands and thoughts (words), and with emotion—manual, verbal, visceral. It is often impossible to characterize an act or a response as exclusively manual, verbal, or visceral; the response was not learned as exclusively manual, verbal, or visceral behavior.

The ancient arrowhead maker presumably kept talking to himself while he chipped his flint—and was emotionally aroused when he smashed his thumb, or "killed" his enemy, or turned out a perfect arrowhead. All manual work above the grade of moron stupidity is probably accompanied by more or less random thinking (verbalization) and by varying waves of emotion—we act as individual human beings, not as motor cars, phonographs, or solar energy.

What were the beginnings of the "masterpieces" of the so-called Higher Life which are enshrined in the hearts, homes, temples, libraries, museums, and curiosity shops of today?

The sequence of steps in the history of Man's verbalized behavior is unknown—the great "monuments" of ancient days are heaps of flint rejects and piles of bone refuse. But deep beneath millennial accumulations of

débris in the French caves human skeletons have been found—skeletons of children, women, and men who had been *buried!* About them were the tools, implements, and weapons used in life, and vessels of food and drink. Those graves are the tangible beginnings of the Cult of the Dead. In later times costly tombs were built and in them was placed literally all that had been held dear in life—including wives, slaves, artisans, guardians, horses, dogs, cats, and birds, all slain that their spirits might attend and comfort their dead master in the realm of the unknown from which no traveler has ever returned!

That *Realm of the Unknown* in one sense is no figure of speech; it has the validity of objective reality; it is as real as the rocks and as potent in human lives as sunshine and rain; it makes and mars lives even though it exists only in Man's "mind" and is made only of words. What is behind the words? We must find a scientific common-sense approach to this so-called intellectual and spiritual world.

The Cult of the Dead is an ancient institution, and, if we include all its ramifications, has been as assiduously cultivated as the Cult of the Living. It is the foundation of all so-called Higher Life. If we can bring it within range of stimulus and response, we can get it into the court of science. If we can describe Man's reactions to "ghosts" in terms of reflex arcs, we can describe all spiritual and intellectual life in terms of reflex arcs—and in so doing we shall see that a "ghost" can outlive its usefulness and frighten humanity out of its nature.

What dug that grave?

Stimulus and response.

The stimulus was the environment, the world at large, the Universe of sun, moon, and stars, the forces of nature—lightning and thunder, wind and waves, rustling leaves and murmuring brooks, light and darkness, day and night, meteors and eclipses, blue sky and

black clouds, rainbows and sunbeams, fire and ice, springs and rivers, eagle's flight and snake's crawl, and birth and death. All these were and are stimuli—to what? Human eyes, and ears, and nose, and tongue, and fingers. Those stimuli were and are *forces*, physical and chemical forces beating against the "windows of the mind" for admission. And the *responses?* As varied as the stimuli themselves. To rain, one response; to an eclipse, another; to a newborn, another. And what were the responses made with? Action in hands and feet, in muscles and glands, in nervous integrations and chemical reactions; with manual, verbal, and visceral mechanisms.

Man was then, no less than are Einstein, Bragg, and Millikan today, stimulated by such forces of nature as reached his senses, to explore them with such powers as he had. Make no mistake about this. The drive behind the earliest investigation of life and death was fundamentally the same drive which today impels the biologist to peer into his microscope—fishermen both for knowledge, searchers into the secrets of nature, trying to find out why the wheels go round. Only, the modern suspects he can never discover the *why*, he hopes he can discover the *how;* he wants to be able to make the wheels go round himself. He searches for knowledge which leads to control.

The observer of ancient days was less bold and observing, and more credulous and garrulous. When he claimed he could talk with dead parents and often did in dreams, who could doubt his word? What is death? No one knows, then or now. To ancient Man, death merely marked a change of garment: the flesh was put off that the "soul" might be free. Why soul at all? In no other way could he account for certain natural phenomena. The hypothesis of spirits was for him a fundamental law of the universe. It "explained" a thousand and one phenomena otherwise to him inex-

plicable. The whole universe of phenomena demanded explanation—he had to explain!

He did explain: he endowed everything in nature with a soul and with human reason; and then accounted for nature by postulating a Creator, in the sky. Could he prove the existence of souls? That was too easy; everybody had seen or talked to a soul. And the Creator? The Creator spoke in thunderclouds and now and then appeared in person on earth to reveal His presence to Man.

Variants of creation myths exist by the dozen. The doctrine of souls or "animate nature" has taken inconceivably diverse forms and led to extraordinarily varied rites, customs, ceremonies, and rituals. Creation myths still survive as the Word, the Book, the Gospel, and endless variants of the soul doctrine survive in countless customs, superstitions, formulæ, and volumes.

Why this survival of primitive science? Modern Man has given up "4004 B.C., nine o'clock in the morning" as the date of creation; he no longer explains fossils by a deluge, nor believes that the whale's stomach was airy enough for a Jonah; yet the overwhelming majority of the human race today believes in ghosts and occult powers, fears devils and black magic. The ghosts will not down nor devils cease their torments!

Stimulus and response.

A disease called smallpox is the stimulus, let us say. Jenner makes "some observations," as advised to do by Hunter; and infers that smallpox is due to such and such causes. He tests that "inference" and finds it complies with observed facts. Vaccine completes the reflex act. Vaccine was the response to the stimulus. Jenner was adjusted: he could "control" smallpox! Ancient Man no less sought *control.*

Souls (spirits, ghosts, ghouls, demons, devils, imps, hobgoblins) could do things! They had great, varied, and very magical power—so Man "observed." They walked in the night and robbed him of his sleep. They

could fly through the air, through trees, through walls, and skim over the water; they could destroy crops, kill cattle, upset canoes, shake the earth, eat up the moon and sun, and take human life in incredible and diabolical ways. These word spirits, created to explain the Unknown, were ever-present stimuli around the fireside. And primitive Man wanted to get control over them! With control, he was adjusted. He responded to souls in a thousand different ways because each soul or category of souls was a different stimulus. But to all soul stimuli his viscera took a hand in the responses. The explicit response might be a prayer or a curse or a platter of food or a new crown for the image or an extra maid to dance for the god; the implicit response was visceral. Man was then, as are men now, afraid of souls!

That fear stimulus is, in general, fatal to further manipulation, but it must be answered!

What Man is afraid of he lets alone or runs from, or propitiates, deceives, or curses; or he borrows, begs, steals, buys, or invents a more fearsome or a more powerful thing to help him adjust himself. Adjust himself he must or remain cowed, and cowed nature is not human nature, however much it may become ingrained through cultural conditioning. That human being who has no adequate response to fear stimuli is society's coward, and may lead the way in panics, but leaves no monument to commemorate his deeds.

Souls were frightful because of their superhuman powers and their diabolical cunning; they could be as real and as terrifying as a man-eating tiger—and have moved as many villages to be abandoned in abject fear.

But most primitive tribes had, and modern societies have, an adequate response to souls and personified nature. I do not now refer to the feasts of All Souls' days or to the tombs and trappings of the dead, nor to the candles on the coffins or the flowers on the graves, nor to the Get-Thee-Behind-Me-Satan Couéisms, nor

to the careful handling of mirrors or the avoidance of ladders, black cats and thirteens, nor to the use of charms, amulets, lucky stones, and four-leaved clovers, nor to the rituals of priests and the rites of the joss; I do refer to the unctuous and flattering response to the Supreme Soul, Ruler of the Kingdom of Souls, Creator of the Universe. For this Illimitable, Eternal, Immortal, and Universal Soul there are as many names as there are languages, and as many ways of approach as there are religious rites and sects. But behind these names of and approaches to is reflex arc action: response to the stimulus to avoid pain, escape the unknown, evade the fearful, and gain immortality. To have made an offensive and defensive alliance with this Ruler of Heaven and Earth and Supreme Trial Judge over the fate (eternal hell fire below or immortal bliss above) of every human being, is for any human being the response of responses; it is adjustment eternal! By that single act of alliance the individual becomes, in one fell swoop as it were, one with the Supreme Soul and partner in control of the Universe. And the earth may go hang and the flesh of the carnal body may rot!

Between the doctrine of souls and the hypotheses of science there can be no reconciliation nor compromise. One springs from fear and stands in awe, the other springs at fear and sits down in peace to look it over; one stakes all on one throw of the dice, the other plays the game to learn it, and, having learned it, learns to play another game. Hence science cannot compete with religion on equal terms; it can offer nothing but itself, it can make no guaranties for the future, nor assert to the mariner that the Pole Star will be in its place tomorrow night—it can only infer that it will. But if tomorrow night the Pole Star has moved, science will tear up its inference and write another to accord with the Pole Star's strange behavior.

Which means that Man can and does vary his responses to his changing cultural environment; other-

wise there would be no culture and probably no Man. But in responses founded in strong emotion change comes haltingly, shyly, and often only long after the proposer of the change has paid the price society demanded as its response to its fear—death.

Reformer (proposer of change), stimulus; society's reaction, fear; response, destroy him. His death adjusts society: the fear stimulus gone, peace prevails; and the blood returns to the business of digestion.

Hence the vast power wielded throughout the ages by the priest, the sorcerer, the medicine man, the Holy One; and naturally—is he not aide-de-camp to the Supreme Ruler and King of Kings? Common people grovel before him, flatter him, fawn on him, bribe him, and kings kneel to him and emperors accept their crowns from his hands. He blesses and he curses, baptizes and marries, rescues infants' souls from hell, and speeds adults' on their way to heaven. Appropriate response to him is adjustment for half of life's situations.

The fundamental principle behind other phases of Higher Life behavior in civilization's rise is the same, whether we deal with Fine Arts, Literature, Ethics, "Intellectual" Pursuits, Morals, or what not. Let us see.

And begin with a newborn babe. What has value in its eyes? Nothing. What makes it blink? It cannot blink for a few days—and then, at dust and bright light. At the age of three it has a few "possessions"—dolls, rattles, etc. These give way to marbles, tops, jackknives, earthworms, fishing tackle, skates, etc., etc. Does the child have an "instinct" of possession? No; it will accumulate enough junk as it is without any instinct. What will it accumulate? Whatever comes to have *value* in its eyes—things, words, phrases, which are of use or can be put to use in responding to stimuli or situations to which it has learned to respond. Coral-island dwellers do not collect coral—they collect cocoanuts and fish. A cocoanut or a fish is stimulus for

action: go get it—it can be eaten; the response has adjusted the individual to the original stimulus, hunger.

In other words, the prized possession of the old arrowhead maker was his pet hammer stone—he may have loved it more than he loved his thirteenth child.

We love our religion because it saves us, our library because it identifies us with the lovers of learning, our trophies because they evince our powers, our amours because they prove our virility, our country because Britannia Rules the Waves or because America is the Land of the Free and the Home of the Brave, and our children because they are ours. We love *ours* because they are ours. The dog may be playing with a clean-gnawed bone and wagging his tail at you; try to snatch that bone away! My child may be a congenital idiot with a harelip and four mammary glands; insult it!

Fine arts? What is a fine art? Who said so? What makes it a *fine* art or a fine *art?* I pay $100,000 for a masterpiece—fourth daughter of the Duchess of So-and-so, by a very rare Dutch master. Is it worth it? It is if I can get $100,000 worth of social adjustment out of it—or sell it for $101,000. Any great loss if it were used as a door mat? Conceivably its value might be increased.

Fine arts, ethics, literature, moral values, intellectual pursuits, etc., are all on a par with fashions in hats and tastes in ties. They have value to some people at certain times in certain countries, under certain circumstances; or they do not have value and are scrapped. Thousands of "masterpieces" in the realms of the Higher Life have been duds until somebody discovered that they could be exploded; whereupon they were exploited for all they were worth.

A certain Viceroy of India proposed that the Taj Mahal be burned for its lime. Here is the formula for his reaction: stimulus, a barracks in need of whitewash; looks for whitewash; sees the Taj Mahal; action in Viceroy's larynx (sometimes called "inspiration"),

"The very thing!"; further action in larynx (sometimes called "logical conclusion" or "profound thought"), "Burn the Taj!" He then considers the Taj as good as burned and the barracks as whitewashed —and thereby ends the reaction; the unwhitewashed barracks have been verbally whitewashed, and he is adjusted.

A later Indian Viceroy's reaction to the Taj led to a quite different response—and the world joined the chorus with, "The most beautiful building in the world." I join that chorus, thereby identifying myself with the world's judges of Beauty. I can further boast that I have seen the Taj by high sun and full moon. In other words, the Taj is one of my "possessions"; I exhibit it by photographs and by word of mouth and muscles of face whenever I have an audience which stimulates me to try a socially or æsthetically valuable adjustment. I do not "exhibit" my Taj to the plumber; he is an ignorant foreigner.

The process of acquiring cultural habits is the same as in the acquisition of any other habit. We can use the "ignorant foreigner" as an illustration.

The phrase "ignorant foreigners," from the lips of those "in authority," heard again and again and with no first-hand knowledge of "foreigners," is as likely today as it was with our early ancestors to become part of our repertoire of verbal behavior and to be accepted as a valid inference, a law. It says that foreigners are ignorant—the inference being that all foreigners are ignorant. Two things follow: one does not need to investigate foreigners to find out whether they are ignorant or not, for the phrase itself says they are; and through early conditioning to the word "ignorant" one is prejudiced against foreigners—one has learned them not as "foreigners," but as "ignorant foreigners."

Children in early times learned, as they do now, conformity not only to the manual ways of their community, but also to the verbalized ways. These verbal-

ized ways represent in general the tribal or community standards of morals and ethics. They are embalmed in folk tales and more formal literature. They make up a great part of the manners and customs, the mores, the folkways of families, tribes, and nations. They are handed down from generation to generation, often without change through long periods of time.

There must be mores, manners, and customs, of course; even ape societies are not without their own ways of social behavior. But through verbal short cuts, shorthand concepts, formulæ, slogans, symbols, and laws, and because all this verbalized behavior is learned with visceral attachments, every human society becomes loaded with attitudes toward countless things which need not be loved or hated, but do need open-eyed investigation. Every community since Man could talk has responded to innumerable social, political, economic, moral, and religious phrases inherited from a preceding generation and accepted as though they represented sound inferences from observed data or were based on observable and verifiable facts. Otherwise, human culture need not have wallowed in ignorance of the observable and fear of the unknown for so many thousands of years.

To put it another way, the psychology of many cultural phenomena is not psychic, but is sugar and adrenalin and other physiological processes issuing through verbalized behavior, making the animal talk big and think great deeds, and commune with the Deity. And most mortals become conditioned in childhood to respect voices of authority, to be awed by thinkers of great deeds, and to be mystified by communers with Deities—even though they commune by gazing through a crystal, or at a liver, or at the signs in the heavens. They learn to follow their leaders; their leaders can always rationalize their behavior by citing the classical formulæ. To act otherwise is to be "irreligious," "un-

patriotic," "immoral," "unethical," "unfashionable," "unbusiness-like," "uncivilized," etc.

Cultural behavior is sometimes called civilization. I suspect that "civilization" is like "art"—a verbal response to a visceral drive whereby we adjust ourselves to a social world of words, in itself a constant and potent stimulus for response. Whatever civilization is, we belong to it, and shine in the glory it reflects on us. We point with pride to it and thereby increase our own importance, for the very act of pointing directs attention to us. And we are generally prone to point with pride if we ourselves are in the picture. We do not point with pride at China or Japan, nor are we certain that their inhabitants are cultured people, though we admit that they exhibit a cultural behavior. But are they as refined, or as intellectual, and do they have the same well-developed mental faculties as . . . and so on for many weary volumes of cross-word puzzles which reach an equally logical conclusion—they satisfy, or they do not satisfy. They are as "intellectual" as the amœba's exploration of a drop of water, and not vital at all, for there has been no response that could turn a mill or shell a pea.

Can and should anything be done about it? Can Man change his nature?

His innate nature, no. Why should he?

Man is by no means physically perfect: some shoddy has gone into his make-up, some of his parts wear out sooner than others. But his innate nature is the product of a thousand million years: he could hardly hope to improve it. He can, however, remove some of the restrictions which now operate to prevent nature from having a fair opportunity to develop strong, virile, happy men and women. He can prevent human infancy from being steadily mowed down by ignorance, neglect, disease, poverty, and squalor, as though these were the will of God!

He can do this by bringing the fruits of chemistry,

physiology, and biology within reach of every boy and girl and of every class and station. That would help to relieve the State of its incalculable and appallingly unnecessary burden of loss through overpopulation and disease. There is every reason why human nature should be known to everybody; and the wise State will see to it that it is known—and it can be, if the school curriculum is relieved of most of its "Literature" and all of its Philosophy, Ethics, Morals, Mind, and Religion. Ignorance must go, especially ignorance of that which is now known about life which must be known to live soundly and sanely.

It is not a question of destroying Beliefs: it is the question of destroying hindrances to observation, to curiosity, to exploration, to learning, to belief in the sensible, to belief in oneself, in one's fellow men, and in the life and happiness and well-being of the human race.

It is not a question of destroying Religion: it is the question of so training boys and girls that human conduct itself becomes more Godlike.

It is not a question of destroying Incentive to live: it is the question of removing incentive to barren, ignorant, and stupid lives; this removed, nature will provide the incentives to live. That is the greatest thing nature does, and Man, with his words and Words, assumes that he can outdo nature in furnishing such incentives! What Man needs is not incentive to live, but opportunity for living. The child does not need to be told that it will go to heaven if it does not go to hell; it does need to be taught to walk and talk straight—and then give it a chance to walk through the natural and it will care little for an incentive to fly like a witch through the supernatural.

The hand that rocks the cradle does rule the world. But the hand these days is too busy to rock the cradle. Meanwhile the next generation is growing up without rules, ruled, or rulers. That is not progress; it is

human nature returning to the ways of the jungle: small family groups, each for itself, each against all. Nor can all the science known to Man alone stem the disintegrating process now at work. Some one must train the child—to walk and to talk fearlessly and honestly, and with due consideration for the concrete fact of the brotherhood of Man.

Altruistic behavior had survival value in the evolution of a human race; but if the human race is ever to see peace on earth, it must control primitive human nature and end its brutish fear of inferiority and hatred of competition: the altruism which established the primitive family must become good-will to all men. Man will continue to be driven by hunger, but he need not become a miser or a glutton, as individual or as nation. There is enough for all if love is the motive power; and human nature is now so well understood that that power can be put to work for more humane ends. "Civilization" is no goal; humanity, *peace on earth,* is. That goal has been dreamed of—and called a "dream," and its apostles have been vilified or crucified by the pillars of society who find in human nature what they put into it and cry: "Human nature cannot be changed —it is God's will!" That cry led to human slavery, human sacrifice, human warfare, and all Man's inhumanity to Man; it should be known for what it is: the retort of the bully and the coward and the armor of the ignorant, the destroyer of humanity and of human happiness. Nothing is known of "God's will"; enough is known of Nature to point the way Man must travel if he is to survive and the goal he must desire if he is to make the most of his nature.

THE END

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